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REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

Sir C. WYVILLE THOMSON, Knt., F.R.S., &c.

REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH

DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

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PART XXXIII.—REPORT ON THE ISOPODA—THE GENUS SEROLIS.

BY F. E. BEDDARD, M.A., F.R.S.E., F.R.M.S., F.Z.S., M.B.O.U.

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EDITORIAL NOTE.

THIS Monograph of the genus *Serolis* is the first instalment of a Report on the ISOPODA collected during the Expedition, by Frank Evers Beddard, Esq., M.A. (Oxon), Prosector to the Zoological Society of London.

Mr. Beddard was for nearly two years associated with me in the work of this office, and I embrace this opportunity of acknowledging the very valuable assistance he rendered in connection with the translation and editing of many of the Reports.

The Manuscript was received on 6th September 1884.

JOHN MURRAY.

CHALLENGER OFFICE, 32 QUEEN STREET,
EDINBURGH, 30*th December* 1884.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the Isopoda collected by H.M.S. Challenger during the Years 1873-76. By Frank Evers Beddard, M.A. (Oxon.), F.R.S.E., F.R.M.S., F.Z.S., M.B.O.U., Prosector to the Zoological Society of London.

PART I.—THE GENUS SEROLIS.

PREFACE.

Among the Isopoda collected during the Challenger Expedition the genus *Serolis* occupies a very prominent position both as regards number of specimens and of new species; for this reason I have thought it advisable to separate *Serolis* from the rest of the group, which will be treated of in the second part of my Report.

As many as sixteen different species were collected during the voyage, of which nine are new. One of these new species was named *Serolis bromleyana*, and briefly described by the late Dr. von Willemoes Suhm in his Preliminary Report on Crustacea observed during the voyage of H.M.S. Challenger;[1] the remaining eight have already been briefly noticed by myself.[2]

Into the systematic part of this Report I have also introduced some account of the remaining species of the genus that were not obtained by the Challenger in order to make the Report more complete.

The portion which deals with the internal anatomy of *Serolis* is unfortunately very incomplete; the specimens were not very favourably preserved for anatomical investigation, and I did not feel justified in using a great amount of material.

[1] *Proc. Roy. Soc. Lond.*, vol. xxiv. p. 585, 1876.

[2] *Proc. Zool. Soc. Lond.*, pt. iii. p. 330, 1884.

A discussion of the systematic position of the genus *Serolis* within the order Isopoda will be best postponed until after a more detailed study of the remaining part of the collection.

With regard to the alleged affinity of *Serolis* (and of the Isopoda generally) for the extinct Trilobites, insisted upon by Milne-Edwards,[1] I have nothing to add to what has already been said; the examination of the Challenger collection of *Serolis* has brought to light no facts which tend to show any close resemblances between the two groups.

I have to thank Mr. E. J. Miers of the British Museum for kindly facilitating my study of the specimens of *Serolis* preserved in the national collection.

HISTORICAL NOTICE.

The first recorded notice of *Serolis* is contained in Fabricius's Systema Entomologiæ, which was published in 1775. Under the name of *Oniscus paradoxus* is a short description of a species subsequently named *Serolis fabricii* by Leach, and which was obtained at the Straits of Magellan during Captain Cook's second voyage.

A few years later (1767) Fabricius briefly defined this species in his Mantissa Insectorum; in both these works *Oniscus* is placed in the class Synistata, which forms the third class of the four into which Fabricius divided what are known now as Arthropoda, and which included, besides the Isopoda, the majority of the Insecta now classed within the orders Hymenoptera, Diptera, and Heteroptera.

In his Species Insectorum, published in 1781, Fabricius gave another description of this species, still under the name of *Oniscus paradoxus;* here Fabricius hints at the Trilobite affinities of the genus "An protypon Entomolithi paradoxi? In multis certe convenit."

In 1798 appeared Fabricius's Entomologia Systematica, which is a considerable advance upon his earlier works. His eighth class, Polygonata, includes all the Crustaceans belonging to Latreille's order Isopoda as well as the genus *Monoculus;*[2] the name *Oniscus paradoxus* is altered to *Cymothoa paradoxa*, and a fuller definition of the genus is given.

Fabricius's *Cymothoa paradoxa* was first recognised as the type of a new genus by the English naturalist Dr. W. E. Leach; in the twelfth volume of the Dictionnaire des Sciences Naturelles, published in the year 1818, is an article by Leach on the Cymothoadæ, where *Cymothoa paradoxa* is redescribed under the name of *Serolis fabricii.*

In 1825 Desmarest in his Considerations generales sur les Crustacés recapitulated Leach's description of *Serolis fabricii.* Both Desmarest and Leach denied the supposed affinities of *Serolis* with the Trilobites.

In 1833 James Eights described in the Transactions of the Albany Institute, vol. ii.

[1] *Arch. d. Mus.*, t. ii. p. 5; *Ann. d. Sci. Nat.*, sér. 6, t. xii. art. No. 3.

[2] *Monoculus* includes all the members of the order Entomostraca.

p. 53, pls. i. and ii., another species of *Serolis* under the name of *Brongniartia trilobitoides*, which name was subsequently altered by Audouin and Milne-Edwards into *Serolis trilobitoides*, since there was evidently no generic difference from *Serolis paradoxa*; this paper contains merely a description of the new form, accompanied by figures in which the whole animal as well as the mouth appendages and the two first abdominal limbs are displayed; a figure of a Trilobite, *Paradoxus boltoni*, is given for the purpose of comparison, but there is no account in the text of any supposed resemblances between the two forms, except the similarity of the eyes. It seems not unlikely that this species is identical with Studer's *Serolis cornuta*, or at most a local variety. This species was obtained on the coast of Patagonia from the stomach of a fish belonging to the genus *Phycis*, and also from the South Shetlands.

The next contribution is a paper by Audouin and Milne-Edwards, which was published in the Archives du Muséum for 1841. This important memoir on the genus *Serolis* contains, after an historical introduction in which all the previous notices regarding the genus are reviewed, a general account of its external characters, and a description of four species—*Serolis paradoxa*, *Serolis trilobitoides*, *Serolis orbignyi*, and *Serolis gaudichaudii*, the two last being here described for the first time; the memoir is illustrated by figures of these species and of all the essential parts in their anatomy; with regard to the affinities of the genus, it is considered as intermediate between the other Isopoda and the Trilobites. Several of these figures are repeated in the magnificent illustrated edition of Cuvier's Regne Animale, edited by his disciples Audouin, Milne-Edwards, Latreille, &c., though the text of this work appears only to contain a description of *Serolis paradoxa*.

The Histoire Naturelle des Crustacés of Milne-Edwards, published in 1840, contains a description of the genus *Serolis* and of the four species *Serolis fabricii* (=*Serolis paradoxa*), *Serolis brongniartiana* (=*Serolis trilobitoides*), *Serolis orbigniana*, and *Serolis gaudichaudii*; in this work *Serolis* is included in the family Cymothoadæ, which is divided into three tribes—(1) Cymothoadiens ravisseurs, *Serolis*; (2) Cymothoadiens errans, *Ægæ*, *Conilera*, &c.; (3) Cymothoadiens parasites, *Cymothoa*, *Nerocila*, &c.

In 1852 Dana described a new species of *Serolis* (*Serolis planus*) in the Crustacea of the United States Exploring Expedition.

Six years later (1858) another species was described by Lütken, to which he gave the name of *Serolis schythei*.

The next and a most important contribution to our knowledge of *Serolis* is Grube's Monograph of the genus, published in 1875. Besides the description of a new species (*Serolis tuberculata*), a general résumé of the external characters of the genus, and some notes on certain species (*Serolis paradoxa* and *Serolis schythei*) that had been previously described, are to be found in this paper, together with a complete list of the then known species, eight in number. Grube regards *Serolis* as being most nearly allied to *Sphæroma*.

During the "Transit of Venus" Expedition to Kerguelen in 1875, two species of *Serolis* were obtained, which were figured and described by Miers, one of these—*Serolis septemcarinata*—being new.

About the same time the German ship "Gazelle" collected a number of species of *Serolis* both at Kerguelen and on the shores of South America, which were described by Studer[1] in 1879. This paper contains, besides the description of a new species (*Serolis cornuta*), a few notes upon the habits of these animals and upon some points in their anatomy.

A few notes upon certain of the species of *Serolis* that are described in the present Report are to be found in v. Willemoes Suhm's Preliminary Report upon the Crustacea collected during the voyage of the Challenger.[2]

Finally, a recently published part of Bronn's Thierreichs (Bd. v. Abth. 2, Heft i.–x.) contains a general account of the Isopoda by Prof. A. Gerstaecker, where some description of the genus *Serolis*, especially of the geographical distribution, is given; there are also in this work a number of figures copied from the Memoirs of Grube and Studer; and a comparative view of the various schemes of classification of the order Isopoda; for this reason I have not in the present Report entered into any account of the systematic positions which have been assigned to the genus *Serolis* by previous writers.

[1] *Archiv f. Naturgesch.*, Jahrg. xlv. Bd. i. p. 104.
[2] *Proc. Roy. Soc. Lond.*, vol. xxiv. p. 585, &c., 1876.

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DESCRIPTION OF THE GENUS.

Serolis, Leach.

Oniscus, Fabricius, Mantissa Insectorum, p. 240, 1787. In Part.
Asellus, Olivier, Encycl. Méth., t. i. p. 252. In Part.
Cymothoa, Fabricius, Entomol. Syst., ii. p. 503, 1793. In Part.
Serolis, Leach, Dict. d. Sci. Nat., t. xvii. p. 340, 1825.
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Definition.—Body much depressed, round or oval in form, usually furnished with long sickle-shaped epimera. Cephalic shield broad, terminating anteriorly in a short median rostrum, uniting with first two segments of thorax to form a cephalothorax. Terminal segment of thorax rudimentary, its tergum unrepresented; sternum partially fused with that of preceding segment; epimera absent. Abdomen consisting of three free segments and a caudal shield; first segment devoid of epimera, and completely enclosed by the preceding and succeeding segments; second and third segments with longer or shorter epimera. Caudal shield usually pentagonal, with one or more longitudinal carinæ, rarely smooth. First pair of antennæ subequal in length to second pair, the former with four basal joints and a multiarticulate flagellum, the latter with five basal joints and a multiarticulate flagellum. Mandibles stout and strong, with a long three-jointed palp. Maxillæ small and delicate. Maxillipedes large and operculiform, entirely covering maxillæ. Ambulatory appendages seven pairs; anterior pair (in male second pair also) modified into a prehensile organ, the terminal joint folding back upon the greatly dilated penultimate joint; last thoracic appendage smaller than the others; first three pairs of abdominal appendages natatory, with broad basal and two expanded distal joints fringed with long plumose hairs; inner joint of second pair prolonged in the male into a penial filament; fourth and fifth appendages branchial; sixth pair natatory, comparatively small.

External Characters.—The depressed form of the body which characterises the family of the Isopoda as contrasted with the Amphipoda is very marked in the genus *Serolis;* in some species (*Serolis schythei*, *Serolis cornuta*, &c.) the body is almost flat; in others again (*Serolis convexa*, &c.) the convexity of the dorsal surface is greater, and *Serolis*

latifrons is conspicuous by its strongly arched dorsal surface, which, together with the shortness of the epimera, causes this species to resemble in general aspect the more typical forms of the Cymothoadæ.

The outline of the body varies from oval (*Serolis tuberculosa*) or even pear-shaped (*Serolis convexa*) to circular, and in the males of *Serolis schythei* and *Serolis cornuta* the diameter of the body from side to side is somewhat greater than the length.

In the majority of the Isopoda the "head" segments become fused with the first segment of the thorax, and form a cephalic shield which is freely movable upon the second thoracic segment. In *Serolis* the disposition of the anterior segments of the body differs much from other Isopoda. The first two thoracic segments are closely united and completely fused dorsally, though the sterna of the two remain distinct; in some species (*Serolis schythei, Serolis neæra,* &c.) an incomplete transverse suture upon the first epimera seems to mark the line of division between the two segments dorsally; in others again (*Serolis antarctica* and all the Australian species) the epimera of the two thoracic segments are completely united, and show no traces of their original distinctness; these epimera are always largely developed, and completely enclose the cephalic shield on both sides. The cephalic shield is very large and has the form of an heraldic shield; it is prolonged in front into a short rostrum; its shape varies considerably in the different species, in some (*Serolis neæra, Serolis paradoxa*) the antero-lateral portions are considerably expanded, and the transverse diameter is greatest here and decreases posteriorly; in other species (*Serolis convexa, Serolis schythei*) the cephalic shield is widest at the level of the eyes. In the majority of species the cephalic shield is separated from the two thoracic segments by a continuous suture; in *Serolis longicaudata* this suture is obsolete behind and indicates the commencement of the formation of a cephalothorax composed of the head segments and the two first thoracic segments as in *Tanais*, with which genus *Serolis* is considered by some to be closely connected. The five following thoracic segments are free; the eighth or terminal segment of the thorax differs from that of other Isopoda in being only represented ventrally by a short sternum, which is more or less intimately fused with that of the preceding segment, and is not prolonged into epimera; the tergum of this segment is entirely undeveloped, and the rudimentary condition of the whole segment (including the appendages, which are much smaller than those of the other thoracic segments) is interesting, inasmuch as in the Isopoda generally the terminal segment of the thorax is only developed very late.

The epimera of the thoracic segments are almost always largely developed in comparison with other Isopoda; and in some of the deep-sea species (*Serolis bromleyana, Serolis neæra*) are extraordinarily elongated, and terminate in sharp spiniform points. As a general rule the epimera are flat and sickle-shaped, curving back and gradually increasing in length up to the sixth pair, which are invariably the longest; sometimes (*Serolis latifrons, Serolis longicaudata,* &c.) the epimera are very short, and hardly exceed

in length those of many Cymothoadæ; where the epimera are only moderately developed they are in close contact for the greater part of their length, the anterior slightly overlapping the posterior; in *Serolis neæra*, *Serolis bromleyana*, and *Serolis gracilis* the epimera are quite independent for the greater part of their length, and are only in actual contact for a short space close to the junction of the epimera and tergum; at this point the anterior margin of the epimeron projects forwards as a short rounded process which is received into a "glenoid" cavity between two similar processes, one dorsal and one ventral, of the epimeron in front; of these processes only traces exist in *Serolis schythei* and those species in which the epimera are closely applied to each other; an intermediate condition is seen in *Serolis paradoxa* and other species, where each epimeron has two articular processes, one anterior and one posterior; the anterior process of each segment overlaps the posterior process of the segment in front.

The epimera of the first three free thoracic segments are invariably separated from their terga by a distinct suture; in some species (*Serolis schythei*) the following pair of epimera are also thus separated; in *Serolis latifrons* all the free thoracic segments have the epimera divided by a suture from the terga.

The *abdomen* in *Serolis* consists of three freely movable segments and a terminal caudal shield which represents the three posterior appendages of the abdomen together with the telson.

The anterior segment of the abdomen is enclosed between the penultimate thoracic and the second abdominal segment, and in one species only has any traces of epimera; in *Serolis latifrons* a minute portion is separated off from the median portion on either side by a suture; and as this suture is quite continuous with those in front which separate the terga and sterna of the thoracic segments, it seems that the minute nodule on either side of the first abdominal segment really represents its epimeron. The two succeeding segments are always furnished with epimera, which are, however, never separated by a suture from the terga, and in most cases are short and not prolonged beyond the lateral margin of the caudal shield; in some species, notably in *Serolis bromleyana*, the epimera of these segments are elongated, and reach midway down the margin of the caudal shield, or even considerably beyond its termination.

The remaining abdominal segments are fused with the telson to form a caudal shield which is commonly more or less pentagonal in outline, and is always furnished with a longitudinal carina and sometimes with a pair of lateral carinæ which appear to mark the line of division between the posterior abdominal segment and the telson; the greater portion of the caudal shield is occupied by the latter.

Appendages.—The two pairs of *antennæ* are generally subequal in size, sometimes (*e.g.*, *Serolis minuta*) the anterior pair, sometimes (*e.g.*, *Serolis cornuta*) the posterior pair are the longer.

The anterior antennæ consist of four joints and a terminal filament, while the posterior

antennæ have a stem composed of five separate joints; the terminal filament is usually shorter than that of the anterior antennæ.

Tactile Organs.—The peculiarly modified antennary hairs first described by Leydig,[1] and believed by him to be sense organs, exist upon the first pair of antennæ only in all the species of *Serolis* that I have examined. These organs are of two kinds, the most conspicuous being cylindrical jointed hairs, several of which are displayed in Pl. I. fig. 4, *b*; each consists of a basal portion somewhat hour-glass shaped, which is attached to the inner side of the upper extremity of each of the joints which compose the filament of the antennules; this is continued into a delicate cylinder with thin walls, which is always divided into two portions by a transverse septum, and occasionally seems to consist of three distinctly separated portions; the distal end of each of these cylinders is formed by a knob-like thickening of the chitinous wall. Leydig describes and figures nerve fibres and cells in these olfactory hairs, but the Challenger specimens were not sufficiently well preserved to show these structures.

As a general rule, only one of these olfactory hairs is found upon each joint of the antennulary filament, but in *Serolis antarctica*, *Serolis australiensis*, and one or two other species, two such hairs are found upon each joint.

The "tactile" organs described by Leydig in the Memoirs already quoted I have only seen in *Serolis schythei* and *Serolis neœra;* on the antennules of these two species one tactile hair only is found upon the distal extremity of the terminal point (Pl. V. fig. 5, *a*); it is a short slender hair, the upper half being plumose. Similar hairs are also found over the general body-surface and upon the first joint of the ambulatory appendages (Pl. III. fig. 11) of many species.

The *mandibles* are very strong and powerful, and furnished with a long three-jointed palp which is longer than the mandible itself; the second joint of the palp is longer than the first joint, and the third, which is very small, is semicircular in shape, and its flat inner margin is furnished with a row of stiff hairs, of which the two distal ones are the longest. These hairs are continued for a short way on to the middle joint of the palp, this part of the joint being of a somewhat greater diameter than the posterior portion, which is devoid of hairs. The basal portion of the mandible is broadest proximally, where it articulates with the head, it narrows abruptly into the distal half, which is not more than one half of its diameter; the latter is bent at an angle to the basal part, terminates in the masticatory edge which is of a dark brown colour, and is either straight or slightly sinuous, or provided with one or two blunt tooth-like projections; in adult specimens only are the mandibles thus furnished with a comparatively smooth edge, which appears simply to be due to wear and tear; in young specimens of all the species

[1] Fr. Leydig, Ueber Geruchs- und Gehörorgane der Krebse und Insecten, *Archiv f. Anat. u. Physiol.*, 1860, pp. 265–314, Tafn. vii.–ix. See also the same Ueber Amphipoden und Isopoden, *Zeitschr. f. wiss. Zool.*, Bd. xxx., Supplement, pp. 225–274, Taf. ix.–xii., 1878.

that I was able to examine the inner edge of the mandibles is strongly toothed. Schiödte, in a memoir upon the structure of the mouth in the Isopoda,[1] has figured and described the mouth parts of *Serolis paradoxa;* the mandibles are distinguished from those of other Isopoda by their blunt edge, which renders them especially fitted for grinding and not for tearing, and Schiödte suggests that the food of *Serolis* probably consists of "such animals as have firm integuments;" in all the specimens that I have examined the stomach contained debris of other Crustacea, frequently recognisable fragments of their own species, besides Diatoms, morsels of the calcareous structure of Echinodermata, &c.; Schiödte is therefore quite right in his supposition regarding the food of *Serolis*, and is no doubt justified in distinguishing this genus from other Isopoda by the characters of its mouth appendages.

The mandibles of *Serolis*, however, possess additional cutting blades and spiniform processes which appear to have been overlooked or imperfectly described and figured by all previous writers with the exception of Schiödte. On Pl. II. figs. 2, 3 are figured the distal extremity of both mandibles right and left of *Serolis latifrons;* the left mandible has upon the upper surface a triangular chisel-like blade, and below this a long spine; the right mandible has the spine, but the cutting blade is smaller. The left mandible of other species is quite similar to that of *Serolis latifrons*, but as a general rule (*cf. e.g.*, fig. of *Serolis schythei*, Pl. II. figs. 12, 13) the cutting blade is not present on the right mandible, its place being occupied by a large spine-like structure. The presence of these structures appears to me to fit the mandibles for tearing as well as grinding.

The asymmetry of the mandibles is marked not only by the differences just mentioned but also by the general shape of the masticatory edge (*cf. e.g.*, Pl. II. figs. 12, 13) and by the fact that one mandible, generally the left, is smaller than the other. An asymmetry of the mandibles appears to be a fairly constant character of the Isopoda.

The *maxillæ* are small and delicate; the anterior pair consist of a narrow basal portion or "cardo," with which is articulated a long flat somewhat curved distal lobe; the free edge of this is furnished with a considerable number of strong spines dark yellow in colour. In some species (*e.g.*, *Serolis pallida*) the lobe of the maxilla is much more bent upon itself and proportionately shorter. In many species I have observed an additional lobe, which is situated below the large masticatory lamina articulating with the cardo (see Pl. V. fig. 14); the presence of this was noticed by Audouin and Milne-Edwards, but subsequently denied by Grube.[2]

The second pair of maxillæ are smaller and more delicate than the anterior pair, but like them consist of a basal portion or "cardo" and a distal portion, which is divided into two lobes, the upper of which is again subdivided; the two anterior are subequal and smaller than the posterior lobe, which is separated by a distinct suture; the free extremities of all bear a number of hairs more delicate than those on the first maxillæ,

[1] *Krøyer, Nat. Hist. Tidsskr.*, ser. 3, vol. iv. (1866); translated in *Ann. and Mag. Nat. Hist.*, ser. 4, vol. i. p. 1 *et seq.*

[2] *Archiv f. Naturgesch.*, Jahrg. xli. Bd. i. p. 214.

and pinnate at their extremity. There are generally two upon each of the smaller anterior lobes and a greater number upon the posterior lobe; in a specimen of *Serolis cornuta* (*cf.* Pl. I. figs. 9, 10) this pair of maxillæ, like the mandibles, was asymmetrical on one side; each of the two smaller lobes had two long hairs upon its free extremity; on the side one of the smaller lobes was markedly larger than the other, and furnished with four hairs instead of two.

In *Serolis convexa* the second pair of maxillæ differ in that all the three lobes are approximately of equal size, and all bear a considerable number of hairs (Pl. VI. fig. 14).

The *maxillipedes* are of considerable size and entirely conceal the subjacent maxillæ; they are closely approximated in the middle line; each consists of a squarish basal portion and a palp; the basal portion is divided by a transverse suture into two, and each of these is again divided by a longitudinal suture; the proximal half or cardo articulates with both the median (sphenoidal plate) and the lateral portion of the sternum. The outer half of the distal half or "stipes," which is generally, though not always, completely separated from the inner "lamina" by a suture, is thin and flat; the lamina is stout, and usually furnished on the inner margin with a row of fine hairs; the upper end invariably bears two thick spines; the palp of the maxilla, which consists of three joints, the middle one the longest, is attached to the lamina about three-quarters of the way down; the second and third joints of the palp are furnished with long hairs on the inner side in all species; the other joints of the maxillipede are sometimes smooth, sometimes furnished with long hairs, according to the species.

The *second thoracic appendage* (*cf.* Pl. VI. fig. 10) is modified into a prehensile organ, the penultimate joint is large and swollen, and the terminal joint is recurved and lies along its inner margin like the blade of a penknife when closed; the inner margin of the penultimate joint has a number of peculiarly formed spines, unlike any that are found elsewhere on the body. Of these there are two kinds which regularly alternate; one set (Pl. VIII. fig. 15) consist of a central stem terminating above in a knob,[1] the margins are beset with a number of fine branches which are fused together on each side for the greater part of their length; the other kind of spines (Pl. VIII. fig. 14) which alternate with these, and are placed slightly more on the ventral side, are long and delicate, expanding above into two processes, one of which is frequently longer and somewhat spoon-shaped, between these the central axis of the spine terminates in an oval knob; the shape of these hairs varies much in the different species, and will be more fully described below under the several species.

The fourth joint of this appendage, which is sometimes (*Serolis tuberculata*) prolonged into a forwardly directed triangular process, is always furnished with two spines, and has in the males of *Serolis convexa* and *Serolis gaudichaudii* a tuft of sensory hairs (see p. 17).

The *third pair of thoracic appendages* in the male (see p. 16) is modified into a

[1] Owing to an error in the plate, this is represented as a forked process.

prehensile organ like the preceding limb, but smaller. In the female it is similar to the succeeding appendages.

The *remaining thoracic appendages* are similar to each other, and are always furnished with tufts of hairs and spines. The first joint, which is always the longest, is generally smooth, or provided on the inner surface with fine plumose hairs like the single sensory hair commonly found upon the terminal point of the filament of the first antennæ. The four following joints are smaller, and generally furnished on the inner and outer side with tufts of sword-like and of serrated spines. In many species (*Serolis antarctica*) these are to a great extent replaced by fine hairs, and in *Serolis neæra* all the thoracic appendages are clothed with fine plumose hairs similar to those which in other species are only to be found upon the abdominal appendages. A more detailed description of the varieties of these hairs and spines will be found under the description of the several species.[1]

The last pair of thoracic appendages (see p. 17) are usually smaller, and very often in the males (*Serolis gracilis*) furnished on the inner side with tufts of delicate sensory hairs like those upon the second thoracic appendage in the males of *Serolis convexa*.

The *abdominal appendages* (see Pl. I. figs. 12–14) are much specialised; the three anterior pairs form "swimming feet"; each of these consists of a proximal joint, the protopodite, which is generally triangular in form and attached to the segment which bears it for about a quarter of the length of the base; the projecting angle bears *three* plumose hairs in the first of these appendages and *two* in each of the two following. In some species (viz., *Serolis schythei*, *Serolis paradoxa*, and in all the Australian species), the protopodite is narrower, less triangular in form, and has *no* hairs. The inner margin is usually clothed with a dense covering of fine delicate hairs, which are also found, though to a less extent, upon the outer border. About half-way between the summit and the base the endopodite is attached, and the exopodite at the summit of the protopodite; both the exopodite and endopodite are delicate semicircular lamellæ, the former being larger than the latter; the outer convex margin of both is provided with numerous plumose hairs which, as shown on Pl. I. figs. 15, 16, consist of a central hollow stem gradually decreasing in diameter towards the extremity, and giving off on either side a series of extremely fine lamellæ; in the interior of the stem I was able to observe, in several cases (Pl. I. fig. 16), a fine thread occasionally looped upon itself and possibly a nerve fibre; the function of these hairs may perhaps be to test the quality of the water coming to the gills.

The lower border of the endopodite in the second of these appendages is prolonged in the male into a penial filament (Pl. VII. fig. 2′, *b*). The next two pairs of appendages consist of a short basal joint laterally elongated, with which are articulated two broad lamellæ, an endopodite and exopodite, which are the gills; the exopodite of the first appendage is

[1] I make an arbitrary distinction here and elsewhere between the finer "hairs" and stouter "spines" in order to express more easily the differences between the ambulatory appendages of different species.

much stouter than its endopodite, and forms an "operculum" divided by a transverse suture, which may be at right angles to the longitudinal axis (*Serolis tuberculata*, &c.) or inclined more obliquely to it (*Serolis schythei*, &c.); very commonly (*Serolis neœra*, Pl. V. fig. 11) the endopodite of this appendage is bifid at the tip, the inner branch being prolonged beyond the outer; in most cases, however, the endopodite is entire; the second pair of gills is always smaller than the anterior pair, the exopodite and sometimes the endopodite is divided by a transverse suture which follows the direction of the suture on the exopodite of the first pair of gills. The terminal appendages of the abdomen or "uropoda" are always comparatively small; in *Serolis antarctica* they are extremely minute; these appendages consist of a triangular basal joint attached by the apex to a notch on the lateral margin of the caudal shield, which varies in position in different species, being sometimes at the anterior end of the lateral margin of the caudal shield, sometimes close to its posterior extremity; the inner angle of the protopodite is always longer than the outer, and the endopodite is longer than the exopodite; in *Serolis latifrons* Studer[1] has correctly described the elongated and spine-like endopodite which becomes completely fused with the protopodite, while the exopodite remain very short; the appendage is capable of being flexed at right angles to the body, and its sharp spiniform character doubtless serves as a protection against many foes.

Sexual Characters.—The generative apertures of the male are always situated on the last thoracic segment, on either side of the median ventral line they are always closely approximated, but differ slightly in different species; in some (*e.g.*, *Serolis antarctica*) they are so close together as almost to form a single orifice; in others (*Serolis schythei*, &c.) they are a little further apart.

The female generative apertures are more widely separated from each other than the male generative apertures; they are situated on the antepenultimate thoracic segment, and have the form of an oval slit, while the male generative apertures are invariably circular.

The ova are carried about by the female until the young are fully formed; the immature females have four ovigerous lamellæ (see Pl. V. fig. 4) developed on the second to the fifth thoracic segments inclusive, which are short, oval in shape, and attached close to the attachment of the thoracic limbs. Studer[2] was the first to point out that these lamellæ become much larger in the mature females with eggs, and overlap each other in the middle line, those on the right generally covering those on the left; this disposition of the ovigerous lamellæ, though general, is not, however, universal; occasionally (*e.g.*, *Serolis convexa*) the arrangement of the lamellæ alternates, the right hand lamellæ of the second segment overlapping that of the left; in the two succeeding segments the left hand lamellæ overlaps the right, and finally the disposition of the lamellæ in the fourth segment is like that in the second. These cases appear, however, to be irregular, and not to be characteristic of different species. When these brood lamellæ are fully developed the sterna

[1] *Archiv f. Naturgesch.*, 1879, *loc. cit.*

[2] *Loc. cit.*, p. 20.

of the thoracic segments undergo a retrograde development and almost disappear, and the animal does not appear to take any nourishment; in all the mature females that I have examined the young appear to be actually contained within the body of the mother, the alimentary canal is pressed up against the dorsal surface of the body, and its cavity is reduced to a minimum; a delicate chitinous membrane is all that remains of the thoracic sterna.

Secondary Sexual Characters.—The males of *Serolis* also differ from the females in a number of secondary sexual characters, which may be divided into two groups—(1) those which are common to all the species of the genus, (2) certain other characters which are confined to one or more species.

1. As a general rule the males of *Serolis* are somewhat larger than the females; this is certainly the case with *Serolis bromleyana* and *Serolis neœra*, in which species the males are not only longer but also broader, owing chiefly to the greater development of the spine-like epimera so characteristic of these two species. In *Serolis cornuta*, *Serolis schythei*, and *Serolis latifrons* the difference in length between the two sexes does not appear to be great, but the males are considerably broader than the females; especially is this so in *Serolis schythei*, where the proportion between length and breadth is almost reversed in the two sexes; in the male the breadth is greater than the length, in the female, on the contrary, the length is greater than the breadth, and the difference between these two dimensions is very near to being the same in both sexes. In *Serolis antarctica* and *Serolis gracilis* the males have a greater antero-posterior as well as transverse diameter than the females.

Among the Australian species, on the contrary, the females appear to be larger than the males, but since the number of specimens in each case was extremely small, it is impossible to speak with certainty. Of *Serolis australiensis* two out of the three specimens are males and smaller than the single female specimen; of *Serolis tuberculata* the Challenger obtained two specimens, one of each sex, and here again the male is the smaller; the male specimen also which has been described by Grube[1] is of about the same size as the male which I have examined; finally, in the only other Australian species, *Serolis pallida*, of which more than a single example was obtained by the Challenger, the female is larger than the male.

In the majority of species of *Serolis* there is a difference in the length of the epimera in the two sexes, and this difference is most strikingly shown in *Serolis gracilis;* in the males of this species the epimera gradually increase up to the sixth, the last thoracic epimera, which are enormously elongated and extend beyond the termination of the caudal shield for a considerable distance.

In the female the epimera are very much reduced in size; the sixth pair, instead of being prolonged beyond the caudal shield, do not reach as far as its extremity.

[1] *Loc. cit.*, p. 227.

In most other species the same conditions occur, and a comparison in detail of the posterior epimera, which differ more in length in the two sexes than the epimera of the anterior segments, will be found under the description of species.

Some few species do not show these differences; in *Serolis paradoxa*, for example, the males, on a superficial view, are indistinguishable from the females, and the difference in size between the two sexes is hardly if at all marked.

As a general rule the sterna of the three anterior abdominal segments serve to distinguish the sex of the individual; in the females the middle portion is commonly prolonged into a stout spine, while in the males this structure is not present, and the posterior margin of the segments is straight or slightly concave. In a great number of species, however, the two sexes do not differ at all in this way.

Another marked secondary sexual character, which is quite universal in the form of the third thoracic appendages; in the females this pair of appendages is entirely similar to the succeeding ambulatory limbs; in the males, on the contrary, the penultimate joint is swollen and furnished on the inner side with a number of peculiar modified spines, the terminal joint is recurved, and the appendage thus forms a prehensile organ very like the second thoracic appendage. Of *Serolis tuberculata* Grube states (*loc. cit.*, p. 230)—"Die Füsse des 2ten Fusspaares sind weniger ausgeprägte Greiffüsse als bei andern Arten; zwar zeichnet sich das 3te und 4te Glied durch seine Kürze vor den entsprechenden der folgenden Beine aus, allein das Handglied ist weniger breit als sonst, sein Innenrand nicht längs der ganzen Schneide mit Zähnen besetzt, und die Klaue scheint nicht so zum einschlagen geeignet zu sein. Die Zähne sind ziemlich lang und stachelförmig mit einer Andeutung von Nebenzacken." The male specimen of this species which I have examined myself does indeed display such differences from the ordinary structure of these appendages in all other *Serolis* as Grube describes; both specimens are, however, evidently immature; the characters that he mentions exactly correspond to the appendages of immature males (see *infra*, p. 27).

These appendages are used by the male during copulation; the claw is firmly imbedded in the epimera of the female, so firmly that the individuals can hardly be separated without injury.[1]

In all species of *Serolis*, as in many other Isopoda, the second pair of abdominal appendages bear a long penial filament; these are a continuation of the lower margin of the endopodite of the limb, and reach in some cases as far back as the end of the caudal shield; in other species they are not quite so long. The end of these filaments is blunt and rounded, and not furnished with any aperture; it seems possible for this reason that the two are approximated during copulation, and form a groove down which the spermatophores pass; the fact of the male generative apertures being placed so closely together seems to favour this supposition.

[1] Studer, Isopoden gesammelt während der Reise, &c., *loc. cit.*

In the females there is no trace whatever of these penial filaments.

2. Under this head I may briefly review certain outward differences in male and female individuals which are peculiar to one or more species, and of which a fuller description is given below.

In *Serolis convexa* (Pl. VI. fig. 10) and *Serolis gaudichaudii* the second pair of thoracic appendages in the male are furnished with a tuft of pinnate hairs upon the inner side of the antepenultimate joint, and in the male of the former species, at any rate, the sterna of certain of the thoracic segments are provided with patches of similar hairs.

In *Serolis septemcarinata* the epimera of the males bear a row of five or six elongated ridge-like tentacles on the under surface which are entirely wanting in the female.

The females of *Serolis neœra* are distinguished from the males by the far greater development of the frontal "sense organ"[1] (*cf.* Pl. V. figs. 1, 3), and the epimera themselves show certain differences in the two sexes, being considerably wider in the male, where the anterior margin from the point of junction with the lateral angle of the cephalic shield slopes gradually backwards and outwards to the termination of the epimeron; in the females the anterior margin passes at first directly backwards almost parallel to the longitudinal axis of the body, and then slopes outwards so that in this sex the anterior epimera look as if a piece had been cut out.

Another sexual difference is found in *Serolis gracilis* and *Serolis convexa*, and is mentioned by Audouin and Milne-Edwards as occurring in *Serolis gaudichaudii*.[2] In these species the terminal thoracic appendages of the males are beset with fine hairs, which are similar in shape to the hairs upon the second thoracic appendages of the males of *Serolis convexa* and *Serolis gaudichaudii;* these same appendages in the females do not differ in any way from the preceding thoracic appendages.

On Pl. II. fig. 6 is figured a single joint from the filament of the second antenna of a male *Serolis schythei;* along the inner margin of the joint are a series of delicate fan-shaped lamellæ which I did not succeed in finding in any female example of this species; it is possible, however, that on account of their extreme delicacy they may have been overlooked.

Alimentary Canal.—The alimentary canal of *Serolis* agrees closely with that of other Isopoda; the point to which I may call special attention is the presence of salivary glands, which I have noticed in *Serolis paradoxa* and *Serolis septemcarinata.* On account of

[1] Grube was the first to point out the presence of a transparent oval area on the first epimera which he imagined might cover some sense organ; Dr. Woodward (*Geol. Mag.*, 1883, p. 21) has compared this structure to certain pores which are to be found in many Trilobites occupying an identical position. I have found that this structure exists in nearly all the species of *Serolis*, generally having the form of a deep and narrow groove surrounded by a specially thickened rim; in *Serolis schythei* and *Serolis cornuta* the structure is precisely as described by Grube in *Serolis paradoxa*, and as in that species there is a pore on the under surface of the epimeron exactly beneath it. In *Serolis antarctica* and others I could discover no trace of it. Concerning the minute anatomy of this "sense organ," I am unfortunately able to say nothing.

[2] *Loc. cit.*, p. 19.

its conveniently small size I selected the latter species for anatomical study by means of transverse sections, which I found much better than dissection owing to the state of preservation of the specimens.

On Pl. X. fig. 6 is figured a transverse section through the head of *Serolis septemcarinata* showing the salivary glands *in situ; a* is the aperture of the mouth, *b* the buccal cavity, and *c* points to the ventral wall of the body bounding the mouth; the salivary glands (*d*) are arranged in rosette-shaped aggregations of cells surrounding a central cavity; these cells are highly granular, and stain deeply with carmine; each is provided with a large nucleus which stains rather more deeply than the surrounding protoplasm; the glands are imbedded in the cellular connective tissue of the body, some of the cells of which are shown in the figure (*e*). Similar structures have been observed by Dohrn[1] in *Anceus* and *Paranthura*, and are figured and described by him in his account of the anatomy of these two genera.

The œsophagus, as in other Crustacea, passes upwards into the masticatory stomach, which is furnished with a complicated series of chitinous plates.

On Pl. X. fig. 9 is figured the masticatory stomach of *Serolis bromleyana* viewed from beneath; the "pyloric" end is directed towards the upper margin of the plate.

There is an upper median azygos cardiac plate (*m*); in front of this and below is a cylindrical plate (*LR, RP*) on either side ("Reibe-platte"), the lower surface of which is traversed by a row of rib-like thickenings. On either side of the median plate are three lateral plates (*l, la, lp*), one median, one anterior, and one posterior; the median lateral plate (*l*) is furnished with numerous fine hair-like processes on the under surface. On the ventral surface of the stomach is a large ossicle (*V*) which reaches beyond the commencement of the dorsal azygos piece (*m*), and terminates in a bifurcate extremity; behind this comes the pyloric portion of the stomach, which has four ossicles on either side; two small triangular ossicles (*t*), situated just above the median piece (*V*), and behind three pairs of elongated ossicles which are furnished with delicate hairs directed inwards and form a sieve-like structure; the outermost ossicle (2) is connected both with the median ventral ossicle (*V*) and the lateral plate (*R.P.*) of its own side; *s* points to the pyloric aperture.

In *Serolis antarctica* the masticatory stomach is entirely similar.

In *Serolis paradoxa* the masticatory stomach apparently differs from that which has just been described by the very incomplete calcification of the cardiac ossicle, which is indeed hardly to be recognised as a distinct ossicle; the ventral median ossicle does not extend so far backwards as in *Serolis bromleyana*, and is less markedly emarginate at its apex.

The masticatory stomach in the two other species in which I have studied it, viz.,

[1] Entwickelung und Organisation von Praniza (Anceus) maxillaris, *Zeitschr. f. wiss. Zool.*, Bd. xx. p. 55, 1870; and also Zur Kenntniss des Baues von Paranthura costana, *Ibid.*, p. 81.

Serolis schythei and *Serolis latifrons*, presents some differences. Fig. 4 is a drawing of the masticatory stomach of *Serolis schythei*, which is entirely similar to that of *Serolis latifrons;* the chief difference from *Serolis bromleyana* is that the lateral ossicle (fig. 4, *l*) is furnished upon the upper surface with short spines in addition to the delicate hairs which clothe its lower surface. The outermost of the three pairs of ossicles which form the pyloric half of the stomach is also more extensive, and bears the ribbed lateral plates (*RP, LP*) upon the anterior edge.

At the junction of the masticatory stomach with the intestine are four cæca which are long and coiled in *Serolis cornuta* (Pl. X. fig. 2); in a specimen of *Serolis neæra* that I dissected there were also four cæca, two situated beneath the gut, and considerably shorter than the other two which lay along the outer margin.

From the masticatory stomach arises the intestine, which is at first wide but gradually narrows towards the rectum; the latter commences at about the level of the fifth thoracic segment, and is separated off from the intestine by an incomplete circular valve; the anus is an oval aperture on the ventral surface of the body between the attachments of the gill plates. The intestine as well as the rectum is provided internally with a series of longitudinal glandular folds.

In a number of small specimens of *Serolis latifrons* mounted on slides in Canada balsam the alimentary canal was distinctly visible; between the wide anterior portion of the intestine and the rectum, which is half its diameter, is a narrow portion of the gut, measuring at its commencement rather less than one half of the diameter of the rectum, and then becoming slightly wider as it approaches the latter.

Nervous System.—The nervous system of *Serolis paradoxa* is figured in Packard's Zoology;[1] Studer has also given a figure and description of the nervous system of *Serolis latifrons;* the former of these two figures appears to represent more strikingly the concentration of the posterior ganglia into a nervous mass where the commissures and connectives between the several ganglia are lost.

I have studied the nervous system of the genus in two species—in young examples of *Serolis carinata* by means of sections and by simple inspection of the entire animal mounted in glycerin; in *Serolis neæra* by dissection.

The nervous system of both these species, as in other Crustacea, shows a relation to the segmentation of the body; the fusion of the anterior segments is accompanied by a fusion of their ganglia, and the same thing has taken place in the posterior region of the body. On Pl. II. fig. 14 is represented the nervous system of *Serolis septemcarinata;* the drawing has been made from a specimen mounted on a slide, but the number of the ganglia has been checked by comparison with a complete series of longitudinal sections through an animal of the same size.

The cerebral ganglia are very large, and present the appearance of being composed

[1] Zoology, Packard, 2nd ed., New York, 1880, p. 307.

of a number of separate lobes; a pair of connectives unite the cerebral ganglia with the ventral chain; the latter is composed of thirteen distinct pairs of ganglia, some of which bear unmistakable evidence of being the result of a fusion between several pairs of primitively distinct ganglia; this is particularly the case with the anterior of the ganglia, which are seen in longitudinal section to be composed of two fused ganglia. The eight following ganglia belong apparently to the thorax. Of these the three anterior[1] are separated from each other by considerably longer connectives than those which unite the posterior thoracic ganglia; the latter get closer and closer together (in correspondence with the diminished size of the segments to which they belong), and the last pair of thoracic ganglia are hardly separated from the fused ganglionic mass belonging to the abdomen; a careful examination of the latter, especially by the help of longitudinal sections, shows that it is in reality composed of six pairs of distinct ganglia, the last of which is considerably larger than the rest, inasmuch as it has to supply the telson as well as the last abdominal segment. The abdominal ganglia occupy only the first three segments of the abdomen.

In *Serolis neœra* the fusion of the posterior and of the anterior ganglia is even more marked.

In the cephalothorax there are three pairs of ganglia, of which the posterior is much the largest. This is united by a long connective with the next thoracic ganglia, which is situated at the posterior extremity of the second free thoracic segment; it is clear, however, that it belongs to the segment in front, since it was quite easy to trace the nerves passing forwards to this segment. The fourth thoracic ganglion is closely connected with the succeeding thoracic and the abdominal ganglia, the whole forming an elongated oval mass lying in the posterior thoracic and anterior ten abdominal segments; the demarcations between the four anterior pairs of ganglia could be recognised by the stout nerves given off on either side to their respective segments; of the posterior ganglia, however, it was impossible to discover how many there were; a vast number of nerve filaments take their origin on either side, and afford no indication of the number of ganglia, two of these passing in a direction parallel to the longitudinal axis of the body from the hinder end of the ventral chain are especially large; they supply the telson.

Eye.—With one exception—*Serolis antarctica*, which is perfectly blind—all the known species of *Serolis* are provided with a pair of eyes situated upon each side of the cephalic shield at about the middle of its antero-posterior diameter; the eye has usually a reniform outline, and in general aspect recalls that of the Trilobite, with which it has been compared; more rarely it is oval (*Serolis bromleyana*), and in *Serolis minuta* it is almost circular.

In all the shallow-water species the eye is relatively small, but very conspicuous from the abundant deposition of pigment; in all the deep-sea forms, with the exception of

[1] This is not clearly shown in the figure owing to an oversight.

Serolis gracilis, in which species the eye seems to be disappearing (see p. 24), it is relatively larger but not so conspicuous, owing to the fact that little or no pigment is present; these external points of difference between the eyes of the deep-sea and shallow-water species are accompanied by very striking differences in their minute structure. Since, however, the shallow-water species agree more closely with other Arthropoda in the structure of the eye, it will be more convenient to commence with them before describing in greater detail the deep-sea species.

Among the shallow-water species I have investigated the minute structure of the eye in the following:—*Serolis schythei*, *Serolis paradoxa*, *Serolis latifrons*, and *Serolis cornuta*. In all there is a fundamental similarity, but there are certain differences in detail.

In *Serolis schythei* the eye (Pl. IX. fig. 2) is facetted externally, and a transverse section shows that each facet forms a doubly convex lens, the posterior convexity being more marked than the anterior. Corresponding to each lens is a vitreous body (*v*) of an oval conical form, and composed, as in other Isopods, of two halves joined in the middle line; as a general rule the vitreous bodies have the even regular form displayed in the figure, but some are uneven, one half being larger than the other; surrounding the vitreous body are the remains of the two cells which gave rise to them, and above, between the vitreous body and the cornea, are two nuclei ("nuclei of Semper") which belong to these cells. The whole "vitrella"[1] is enclosed in a sheath of deep black pigment cells.

Below the vitrella is the retinula, which consists of only four cells; this is an unusually small number; from Grenacher's work upon the Arthropod eye already quoted, it appears that five or seven cells is the usual number, and in some cases the retinula contains a greater number of cells; *Gammarus locusta* would seem to be the only known Crustacean besides *Serolis* in which the retinula is composed of so few as four elements. Each of the retinula cells is club-shaped when viewed in front (fig. 2); seen laterally they are hatchet-shaped (figs. 18, 19); at about the middle of the cell is an oval swelling where the nucleus is situated; the nucleus is oval in form, the long axis corresponding to the long axis of the cell, and is contained in a cavity; in the interior of each nucleus is a small highly refracting nucleolus. The retinula cells are clothed externally with a coating of pigment, which is more especially developed at the upper swollen extremity and gradually decreases in amount towards the lower end; this pigment appears to be contained in long branched connective tissue cells. The retinal cells themselves, however, do contain intrinsic pigment in addition to this adventitious sheath, as is shown by transverse sections. Fig. 20 represents a series of sections through a single retinula at various points which are indicated in the description of plates; from these sections it may be seen that the retinal cells contain abundant pigment granules within their own

[1] The nomenclature used in this description is taken from Grenacher's Untersuchungen über das Sehorgan der Arthropoden, Göttingen, 1879; and from a Memoir on the Eyes of *Limulus* and *Scorpio* by Prof. Lankester and Mr. A. G. Bourne (*Quart. Journ. Micr. Sci.*, N. S., vol. xxiii. p. 177, 1883).

substance, especially towards the circumference. The nuclei of the pigment cells become conspicuous in teased preparations of the eye depigmented by means of nitric acid.

At the upper extremity of each retinula cell, and lying upon the inner margin, is a clear chitinous rod, the "rhabdomere" (fig. 18, *r*); the four rhabdomeres are more or less closely united to form the rhabdom, which is shown in figs. 2, 5, *r*; the lower extremity of the rhabdom is produced into a fine thread, reaching nearly as far as the pigmented membrane which bounds the inner surface of the eye. Below this membrane, which is of some thickness and pigmented only upon its upper surface, the retinal cells are continued into stout nervous rods which are slightly swollen at the upper end, where they come into contact with the retinal cells.

The pigment sheath of the retinal cells is continued for a short distance along the nerve rods; the latter exhibit transverse markings, and are a little like striated muscular fibres; it is very likely that these structures in other Crustacea have contributed to the erroneous idea that the Arthropod eye possesses intrinsic muscular fibres serving as a focusing apparatus. It has, however, been clearly shown by several investigators that there are no such muscular fibres present.

So far the eye of *Serolis schythei* only differs from that of other Isopoda in unimportant details. I now proceed to describe another structure which enters into the composition of the eye in all the species of *Serolis* that I have examined, but which has not to my knowledge been figured or described as occurring in the eye of any other Arthropod; this structure consists of two large hyaline bodies situated below the rhabdom, and enclosed by the upper extremities of the four retinal cells (fig. 2, *h*). Occasionally only one seems to be present in a single retinula, and very often the size of the two is unequal, one being considerably larger than the other (fig. 10). Each of these bodies is clear and transparent, the substance of which it is composed having very much the appearance of chitin, and I was at first inclined to think that the whole structure in all probability represented the rhabdom of other Arthropod eyes. Seeing, however, that a rhabdom is present—though rather small and inconspicuous—this comparison cannot hold good, and moreover each of these hyaline bodies shows an irregularly shaped granular mass, deeply stained by carmine and other reagents, which would seem to be a nucleus; it is evidently therefore an independent structure and not a product of the retinal cells; the lower end of the rhabdom is imbedded in these two cells, and the filiform prolongation of the same appears to pass through their substance. The large size and transparency of these hyaline cells seems to indicate that they serve as a dioptric medium. I am not able to say whether these structures represent highly modified retinula cells or intrusive connective tissue cells, inasmuch as I have found them already well-developed in the youngest specimens that I have examined.

In *Serolis paradoxa* the structure of the eye is in most respects similar, but each of the cells which compose the retinula secretes in addition to the rhabdomere a small highly

refractive lens-like body or "phaosphere." The shape of these bodies as well as their position varies considerably; sometimes they are quite spherical, occasionally they are oval, and more rarely bean-shaped; they are more usually found in front of the nucleus of the retinula cell, sometimes within its swollen anterior extremity; often they lie behind the nucleus, and in a few cases they were observed in close contact to the nucleus and slightly to one side. The phaospheres of all the four cells of a single retinula in some instances occupied an approximately similar position, though more generally this was not so.

I only succeeded in making out these structures in *Serolis paradoxa;* in *Serolis schythei* and *Serolis cornuta* they appear to be absent.

Serolis cornuta.—In this species the cells composing the retinula are longer and more slender than in *Serolis schythei* or *Serolis paradoxa*, and the pigment upon their outer surface is comparatively feebly developed, being chiefly massed round the rhabdom; in other respects their structure is similar, and very thin longitudinal sections show that intrinsic pigment is present within the cells themselves in addition to the intrusive pigmentiferous connective tissue corpuscles which clothe them externally. The rhabdom is a remarkably complicated structure, and differs greatly from the simple rhabdom found in the two species just described. It is displayed in figs. 3, 9–15, which have been drawn from preparations teased out in glycerin after having been depigmented by means of nitric acid and in figs. 7, 8, 16, 17, which represent longitudinal sections of this portion of the eye undepigmented. In the latter the rhabdom is seen to consist of a number of coiled threads running in various directions and coated externally with a thick layer of black pigment. The lower extremity of the rhabdom projects into the "hyaline cells" and is surrounded by their substance. In fig. 4 is displayed a teased preparation of the eye of *Serolis cornuta* undepigmented, and it may be seen that the rhabdom ends below in blunt rounded prolongations which project into the "hyaline cells"; the lower extremity of each of these prolongations—which indicate the composition of the rhabdom out of four rhabdomeres—is devoid of pigment, so that the rays of light can pass through. In longitudinal sections of course only one or two of these can be seen, though there are in reality four.

The shape of the rhabdom can best be made out by teased depigmented preparations; fig. 3 represents a single retinula prepared in this way; the rhabdom is here seen in profile and resembles an irregular coil of rope projecting below into the hyaline cells (*h*) and continued into a thin filamentous prolongation which appears to pass through the substance of these cells or between them, and extends nearly as far as the lower end of the retinula cells. Figs. 9–15 represent the rhabdom and the two hyaline cells viewed in such a position as to bring out the symmetrical character of the former. The form of the rhabdom, however, differs widely in detail; some of the varieties are displayed in these figures; in all it appears to consist of a median unpaired portion which is continuous below with four symmetrically arranged portions which project into the substance

of the two hyaline cells; the median portion is usually formed by a sinuous rod of varying length, which ramifies at its lower extremity into four coils; the whole structure reminds one very forcibly of the Malpighian bodies of the kidney; in some cases the median rod is double, and more rarely (fig. 13) it is represented by four or five pieces; it is possible that these varieties correspond to stages in growth, the more complicated (*e.g.*, figs. 11–13) being the older.

The "hyaline cells," as already mentioned, are two in number in each retinula; the nucleus is situated close to the lower extremity; in sections which have been slightly depigmented the whole of these hyaline cells becomes tinged of a light mahogany brown, with the exception of the nucleus, which remains unstained, and is therefore exceedingly conspicuous; in, *e.g.*, figs. 16, 17, which are drawn from such sections, it may be seen that these cells enclose almost the whole of the rhabdom, and this would seem to suggest that they are concerned in its production and may therefore perhaps be modified retinula cells; the cells themselves are quite homogeneous and transparent—apart, of course, from the nucleus—and in section appear exactly similar to the vitreous body; they are, however, more transparent and quite colourless, whereas the vitreous body is always of a chitin-yellow colour. In a teased preparation of the eye of *Serolis cornuta* the addition of strong nitric acid dissolves out the pigment, which is at first absorbed by the hyaline cells, causing them to assume a very remarkable appearance, represented in Pl. X. fig. 1; these cells become quite granular with a crenated outer margin and of a dark greyish-black colour; when the process of depigmentation has gone on a little further the pigment is dissolved out of the hyaline cells, leaving them perfectly transparent and smooth, or at most with a slight mahogany brown tinge.

Among the deep-sea species of *Serolis* the eye is entirely absent in *Serolis antarctica;* its place, however, is occupied by a small tubercle not more than 1 mm. in extent, on either side of the cephalic shield; the posterior border of the latter in consequence is more regular, and the postero-lateral projections which correspond to the eyes are but slightly marked; the two tubercles have the same microscopic structure as the rest of the chitinous integument, and show no traces of facets; their interior is filled with a plug of connective tissue, in which no vitreous bodies or retinal elements could be detected. In *Serolis gracilis*, another deep-sea form, the eyes present some curious peculiarities. In two specimens the eyes are well developed, though small, and resemble entirely the eyes of *Serolis bromleyana;* they are conspicuous from their whitish colour, which contrasts with the surrounding integument; in one specimen the ocular protuberance is only partly occupied by the optic tissues, the rest being exactly similar in colour to the general integument of the body; in another specimen there is no trace whatever of any optic structures, though the oval-shaped elevations of the eye are present but dark bluish in colour like the rest of the integument. In this species, therefore, the eye seems to be just on the verge of disappearance.

Serolis bromleyana.—That portion of the chitinous integument that covers the eye is modified and differs from the rest by its comparative thinness, and by the absence of the characteristic scale-like sculpturing; corresponding to each element of the eye is a thickening of the cornea, which is, however, very slightly developed in comparison with other species, and indeed the two surfaces of the cornea appear in transverse section to form two nearly straight parallel lines, the lower surface alone showing a series of undulations of unequal extent. Pl. X. fig. 5, and Pl. IX. fig. 2, represent transverse sections through the cornea of *Serolis bromleyana* and *Serolis schythei* respectively; the conspicuous corneal lenses of the latter type are in very marked contrast to the feeble indications of these structures in *Serolis bromleyana.*

The tissues of the eye itself have evidently undergone considerable degeneration, and this, coupled with the fact that the specimens were by no means well preserved, renders any satisfactory comparison of their structure with that of the shallow-water species of *Serolis* and the Arthropoda generally extremely difficult. I describe the facts as they appear to me.

Pl. X. fig. 5 is a diagrammatic representation of a transverse section through the eye; beneath the cornea are a series of more or less cup-shaped masses of unequal size and of a granular appearance; occasionally several of these bodies appeared to have become fused together at their upper extremity, and in a few instances a short upward prolongation of the subjacent tissue into the substance of the body gave it the appearance of being originally formed out of two separate halves; the granular yellowish coloured matter of which these structures consist is almost entirely unaffected by carmine, which stains deeply the surrounding tissues, and is only slightly stained by hæmatoxylin. In teased preparations of the eye these structures are easily separated, and are seen to have an oval contour; from their position they would appear to correspond to the vitreous body, and in their general characters recall the vitreous bodies of the type of eye termed by Grenacher "pseudoconous." The compound eyes of the Arthropoda have been arranged by Grenacher[1] into three groups—(1) euconous eyes, (2) aconous eyes, and (3) pseudoconous eyes. In the first group the cells lying behind the facets secrete in addition to it a highly refractive vitreous body or "Kristallkegel," which is composed of as many segments as there are cells; in the second group the cells remain unaltered and secrete no vitreous body; in the third group these cells secrete "a soft fluid or semifluid substance" which represents functionally the vitreous body of euconous eyes. It seems to me very possible that the granular appearance of the vitreous body in the deep-sea *Serolis* has been caused by the coagulation (by alcohol) of a semifluid substance. Pseudoconous eyes, which according to Grenacher are only to be found in the order Diptera, are further distinguished from euconous eyes by the fact that the nuclei of the cells of the vitreous body (the so-called "nuclei of Semper") remain *below* the

[1] Sehorgan der Arthropoden, Göttingen, 1879.

vitreous body itself, instead of being placed *above* it and in close proximity to the cornea.

I was unable to detect with certainty these nuclei of Semper in the eye of *Serolis bromleyana*, but in another deep-sea form, *Serolis neæra*, having an eye of similar structure they were very conspicuous, and situated above the "vitreous body" between it and the cornea. Each of the vitreous bodies of *Serolis bromleyana* is enclosed in a cup-shaped sheath of tissue (Pl. X. fig. 5) in which no trace whatever of any structure could be made out. This sheath possibly corresponds to the pigment sheath which encloses the vitreous body in other Arthropoda, but in *Serolis bromleyana* it is entirely free from pigment. Below this portion of the eye, and corresponding to each of the vitreous lenses, is a roundish mass of cells which are separated into groups by ramifying trabeculæ of pigmented connective tissue; from the posterior end of this mass of cells a delicate bundle of nerve fibres arises which passes back to the ganglion; it is clothed externally by a layer of pigmentiferous ramified cells continuous with those in front.

The eyes of *Serolis neæra* resemble in external characters the eyes in the shallow-water species of *Serolis;* they are distinctly faceted, and a great deal of pigment is present; they are also proportionately larger than in any of the shallow-water species.

The minute structure, however (fig. 3), agrees in the main with that of *Serolis bromleyana*, but is a little less degenerated; the cornea, as already stated, is distinctly faceted; beneath each facet are two large and conspicuous nuclei ("nuclei of Semper"), these are round or oval, sometimes pear-shaped; they are surrounded by a distinct membrane showing a double contour, and contain a highly refractive nucleolus. The vitreous bodies, like those of *Serolis bromleyana*, are of an irregular oval form and granular opaque consistency; the upper half is encircled by a ring of pigment. At the lower end of each is a roundish mass of small nucleated cells (*g*), probably nerve cells, and these are connected posteriorly with a nerve bundle, partly sheathed with pigment cells, which extends into the mass of nerve cells dividing it up into lobules. Fig. 8 is a single element isolated by teasing in glycerin; the vitreous body (*V*) is very distinctly cup-shaped.

The results of my investigations into the minute structure of the eye in *Serolis* may be briefly summed up as follows:—(1) The shallow-water species invariably possess well-developed eyes which are fundamentally similar to those of other Isopoda, but differ in several particulars; the retinulæ are composed of only four cells; the rhabdom is often a highly complicated structure unlike that of other Crustacea. Another element unrepresented (?) in the eyes of other Crustacea is present, consisting of two large hyaline nucleated cells placed below the rhabdom and between the retinal cells. (2) In the deep-sea species the eyes are either altogether absent (*Serolis antarctica*), or, if present, show signs of structural degeneration; no retinula, at least nothing comparable to the retinula in the eyes of the shallow-water species, is present, but the vitreous body is represented. The vitreous bodies may be enclosed in a sheath of

pigment (*Serolis neœra*), or there may be no pigment present (*Serolis gracilis, Serolis bromleyana*).

Development.—Several of the species of *Serolis* contained eggs within the brood cavity in various stages of development, and although these embryos were not sufficiently well preserved to admit of any examination by means of sections, I have been able to note down some developmental facts which have an important bearing upon the affinities of the genus. The development history of *Serolis*, so far as I have been able to trace it, is strikingly similar to that of the Cymothoadæ, which has recently been worked out in detail by Mr. J. F. Bullar.[1] The Isopoda generally differ from the Amphipoda in that the embryo has a dorsal flexure in the former group and a ventral flexure in the latter. Thus Fritz Müller (Facts for Darwin, p. 71) says—"The curvature of the embryo upwards instead of downwards was met with by me as well as by Rathke in *Idothea* and likewise in *Cassidina*, *Philoscia*, *Tanais*, and the Bopyridæ; indeed I failed to find it in none of the Isopoda examined by me." And at p. 74—"The Amphipoda are distinguished at an early period in the egg by the different position of the embryo, the hinder extremity of which is bent downwards." In the Cymothoadæ—at least in those species which are treated of by Bullar in the paper from which the above quotation has been made—the embryo is intermediate between the typical Isopoda on the one hand and the Amphipoda on the other; it only occupies the ventral surface of the egg, and does not extend so far towards the dorsal surface as in the Isopoda generally, and the telson is bent downwards as in the Amphipoda. In *Serolis* the embryo is exactly similar, and on Pl. X. fig. 7 I have figured a young embryo of *Serolis antarctica;* if this figure be compared with the figures of *Cymothoa* in Mr. Bullar's paper, the close similarity between the two will be at once apparent.

This fact appears to me to be very strong evidence in favour of Milne-Edwards's view concerning the zoological position of the Serolidæ, which are regarded by him as a division of the Cymothoadæ.[2]

Post-Embryonic Development.—As in many other Isopoda, the males of *Serolis* when first hatched show none of the distinctive secondary sexual characters of males; the time at which they assume these characters differs in different species.

In *Serolis cornuta* the males are at first exactly like the females in general aspect; the body is more oval than in the fully-developed males, being considerably narrower proportionately; the thoracic appendages of the third pair are, as in the females, similar to the succeeding thoracic limbs; the penial filament of the second abdominal appendages is short, and the sterna of the free abdominal segments resemble those of the female in being

[1] *Phil. Trans.*, vol. clxix. p. 505, 1879.
[2] *Hist. Nat. d. Crust.*, 1840, t. iii.

furnished with a median spine. On Pl. I. are figures of a female (fig. 2), a fully developed male (fig. 1), and a young male (fig. 3) of *Serolis cornuta*, which are drawn exactly of the natural size; and judging from the very slight difference in length between the immature and the fully developed male, it would appear that the male does not acquire all its secondary sexual characters until the last moult, though the comparatively greater breadth of the body, which also distinguishes the males of this species from the females, is recognisable somewhat earlier.

The comparatively small number of specimens (seven) of *Serolis neœra* makes it impossible to state with any accuracy the time at which the males assume their proper sexual characters; the facts are as follows—of the four male species two are completely adult, measuring 42 mm. in length, the remaining two are immature, the largest measuring 25 mm. in length; this specimen has the general appearance of a female in its comparatively short epimera, absence of modification in the third thoracic appendage, and in all the other secondary characters by which the males of this species differ from the female, with the exception of the frontal "sense organ," which resembles that found in the adult males, and is not greatly developed as in the females; from this it appears that those secondary sexual characters in which the males of this in common with other species differ from the female appear comparatively late, while the one sexual character peculiar to the species is developed early.

In *Serolis schythei* the males reach maturity much sooner than in *Serolis cornuta;* the largest male specimen in the Challenger collection measures 30 mm. in length by 38 mm. in breadth; the smallest male specimen, with fully developed secondary sexual characters, is 16 mm. long by 19 mm. broad; another male specimen, in which the sex could only be detected by the position of the generative apertures and by the short penial filament, measures 15 mm. in length by 17 mm. in breadth; in this species, therefore, the secondary sexual characters which distinguish the male appear comparatively early, and in immature males, which in other respects are outwardly like the females, the greater proportionate breadth is recognisable; this character is the first to appear, as also apparently in *Serolis cornuta.*

Serolis bromleyana.—In this species the males differ from the females in the third thoracic and second abdominal appendages, and also in the epimera, which are shorter in the female and slope downwards at a less angle with the longitudinal axis of the body. The young males, as in other species, are closely similar to the females, but acquire the secondary sexual characters peculiar to the males at a comparatively early period; the largest male specimen of *Serolis bromleyana* measures 54 mm. in length, the smallest male, which shows all the secondary characters peculiar to its sex, measures 25 mm. in length; the largest male specimen, which has not yet acquired its proper secondary sexual characters, is 21 mm. in length; another specimen 22 mm. in length is nearly adult; the penultimate joint of the third thoracic appendage is swollen

as in the males, but the terminal claw is not yet reflected back. A single male specimen of this species was dredged at Station 164A, which presents some interesting peculiarities in this respect; although only 15·5 mm. in length, it has all the secondary sexual characters of an adult male; the epimera are long and project outwards, the anterior ones nearly at right angles to the longitudinal axis of the body, and the third thoracic appendages are fully developed into prehensile organs; the three middle joints of these appendages, however, are not provided with the soft sensory hairs which I have noticed in nearly all the specimens from Station 168; the large male specimen from Station 156 is also characterised by the same absence of sensory hairs upon this appendage, and it appears to me to be just possible that the males of this species are dimorphic, one set being characterised by the possession of tufts of sensory filaments upon the third thoracic appendages, and the other set differing by the absence of those structures, and also by the fact that the individuals acquire their own proper secondary characters at an earlier date. It is also possible, of course, that this character may be a mere local variation, but in this case its occurrence in individuals from two such widely separated localities as Stations 164A and 156 is not a little remarkable, especially when we consider that the depths which the species inhabit are so different (400 and 1975 fathoms) in these two localities.

The time at which the females of *Serolis* attain to sexual maturity corresponds in every case to that observed in the case of the males.

In *Serolis cornuta* only the largest female examples had the ovigerous lamellæ fully developed, though rudiments of these structures are apparent in many of the smaller individuals.

In *Serolis schythei*, corresponding to the early sexual development of the male, the Challenger collection contains a female specimen only 13 mm. in length, but having the brood lamellæ fully developed and containing eggs.

Of *Serolis bromleyana* there is an adult female dredged at Station 168, only 22 mm. in length; in this species, as already stated, the males acquire their secondary sexual characters at a corresponding age.

DESCRIPTION OF SPECIES.

The following is a complete list of all the species of *Serolis* that are known to me either from the specimens contained in the Challenger Collection or from published descriptions, with the localities and depths at which they occur, and a reference to the first published description; they are arranged in order of discovery.

1. *Serolis paradoxa* (Fabr.) (= *Serolis orbignyi*, M.-E.), Mantissa Insectorum; Patagonia and the Falkland Islands, New Zealand (?), Senegal (?), 5 fathoms.
2. *Serolis trilobitoides* (Eights), Trans. Albany Inst., 1833; South Shetlands, Patagonia, a few fathoms.
3. *Serolis gaudichaudii*, Aud. and M.-E., Arch. d. Mus., 1841; Valparaiso, a few fathoms.
4. *Serolis planus*,[1] Dana, United States Expl. Exp.—Crustacea, part ii. p. 794, 1852; Patagonia, a few fathoms.
5. *Serolis convexa*, Cunningham, Trans. Linn. Soc. Lond., 1871; Patagonia, a few fathoms.
6. *Serolis schythei*, Ltk., Vidensk. Meddel. f. d. nat. Foren. i Kjøbenhavn, 1858; Patagonia, 4–55 fathoms.
7. *Serolis acutangula*, Gr.; Locality ?
8. *Serolis tuberculata*, Gr., Archiv f. Naturgesch., 1875; Bass Strait.
9. *Serolis latifrons* (White), Miers, Ann. and Mag. Nat. Hist., Ser. 4, vol. xvi.; Kerguelen, Crozets, Acukland Islands, 1–210 fathoms.
10. *Serolis septemcarinata* (Miers) (= *Serolis ovalis*, St.), Ann. and Mag. Nat. Hist., Ser. 4, vol. xvi.; Marion Island, Prince Edwards Island, Kerguelen, 1–150 fathoms.
11. *Serolis cornuta*, Studer, Archiv f. Naturgesch., 1879; Crozets, Kerguelen, 1–120 fathoms.
12. *Serolis serrei*, Lucas, Bull. Ent. Franç.; Patagonia, a few fathoms.
13. *Serolis carinata*, Lockington, Proc. Calif. Acad. Nat. Sci.; San Diego, California.
14. *Serolis bromleyana*, Suhm, Proc. Roy. Soc. Lond., vol. xxiv. p. 591; off east coast of New Zealand, between New Zealand and Australia, at lat. 37° 53′ S., long. 163° 18′ E. (near Antarctic Ice-Barrier), 410, 700, 1100, and 1975 fathoms.
15. *Serolis neœra*, F. E. B., Proc. Zool. Soc. Lond., 1884, pt. iii. p. 331; off Rio Janeiro, 600 and 2040 fathoms.
16. *Serolis gracilis*, F. E. B., *loc. cit.*; off Pernambuco, 675 fathoms.
17. *Serolis antarctica*, F. E. B., *loc. cit.*; off Pernambuco, 410 fathoms; near Crozets, 1375 and 1600 fathoms.
18. *Serolis australiensis*, F. E. B., *loc. cit.*; Australia, 38 fathoms.
19. *Serolis elongata*, F. E. B., *loc. cit.*; Australia, 30 fathoms.
20. *Serolis pallida*, F. E. B., *loc. cit.*; Australia, 35–40 fathoms.
21. *Serolis longicaudata*, F. E. B., *loc. cit.*; Australia, 38 fathoms.
22. *Serolis minuta*, F. E. B.; Australia, 38 fathoms.

From the above list it will be seen that the new species obtained by the Challenger are nearly as many as those previously known. Besides the nine new species already briefly

[1] It seems to me legitimate to alter the termination "*us*" into "*a*" as done by Grube; I have accordingly followed Grube in the text.

noticed by myself and by Dr. v. Willemoes Suhm, there are in the Challenger collection seven other species which have been more or less fully described by previous writers; these are *Serolis paradoxa*, *Serolis schythei*, *Serolis convexa*, *Serolis tuberculata*, *Serolis latifrons*, and *Serolis septemcarinata*; some notes upon these species will be found below.

Of the remaining six species, *Serolis acutangula* is probably identical with some other form, since Grube, who originally described it in 1871, omits all mention of it in his subsequently published (1875) Monograph of the genus; it is therefore useless to recapitulate or make any comments upon his description here. I have quoted the reference to this description in the list of papers at the beginning of this Report. *Serolis trilobitoides* is closely allied to if not actually identical with Studer's *Serolis cornuta*; the figure of this species which is given by Eights is not very good,[1] and the description, which does not entirely agree with the figure, is not quite complete enough to make it certain whether this is a good species or not.

Serolis plana certainly comes very near to *Serolis convexa*, and under the description of the latter species I have indicated the points of resemblance and difference between the two. *Serolis gaudichaudii* resembles very closely both *Serolis plana* and *Serolis convexa*, but is nevertheless an undoubtedly distinct species; the points in which it differs from the two latter are indicated under the description of *Serolis convexa*. The two remaining species, *Serolis serrei* and *Serolis carinata*, require a fuller description.

The former species is described by Lucas in the following terms:[2]—"Elle est plus large que longue, arrondi, testacée et finement tachée de points bruns. Les six premiers segments thoraciques constituent de très grandes lames pointues falciformes ponctuées, transparentes et non dentelées sur leur bordes comme chez le *Serolis trilobitoides*. Le dernier segment abdominal, tricaréné non dentelé, plus large que long arrondi et légèrement sinueux dans le milieu de son bord postérieur presente une épine assex grande, aiguë, de chaque côté de ses bords latéro-postérieures. La région buccale, les pattes ainsi que tout le dessous du corps sont d'un jaune testacé. Les antennes sont testacées maculées de brun." This species, which attains a length of 27 mm. and a breadth of 36 mm., was obtained by the French vessel "Magicienne" in the Strait of Magellan. Lucas mentions that it is closely allied to *Serolis trilobitoides*, but it seems to me, from the above quoted description, that it is probably more nearly related to *Serolis schythei*.

It is to be hoped that a fuller description of this species as well as of *Serolis carinata* will be published. *Serolis carinata*, which is one of the most interesting species of the

[1] Studer (*Archiv f. Naturgesch.*, *loc. cit.*, p. 21, note) refers to a supposed error on the part of Eights; the anterior antennæ are said to be represented in Eight's figure as if they originated below instead of above the posterior antennæ. This is not, however, the case with Eight's figure, but with Audouin and Milne-Edwards's copy of the figure which is introduced into their Monograph of the genus (*loc. cit.*, pl. ii. fig. 11); the absence of shading here does make it appear as if the anterior antennæ originated below the posterior.

[2] *Bull. Soc. Ent. Franç.*, sér. 5, t. vii. p. cxlv and cxlvi.

genus, on account of its occurrence so far north as California, has been briefly characterised by Lockington[1] as follows:—"Thorax and abdomen conspicuously keeled upon the centre of every segment; the first segment slightly waved on its posterior margin, the curve of the segments increasing rapidly in such a manner that the last entirely encloses the free abdominal segments on their sides. Caudal segment rounded at the extremity, with two marginal teeth on each side at a considerable distance from the extremity, the central carina running the entire length of the segment; last basal joint of inner antennæ longer than the flagellum; flagellum of outer antennæ much shorter than either of the two of the preceding basal joints, and last basal joint about equal in length to the penultimate. Eyes large, reniform, conspicuous. The texture of the upper surface of a dried specimen under a two-thirds power has a somewhat squamate appearance. Colour a greyish-brown, diversified with dots and irregular markings of black; hands long and slender; dactylos equal in length to the manus.

"Length, 0·21 inch; width, 0·16 inch."

Two specimens from San Diego, California.

1. *Serolis paradoxa* (Fabricius) (Pl. V. figs. 12–14).

Oniscus paradoxus, Fabricius, Mantissa Insectorum, Hafniæ, 1787, t. i. p. 240; Systema Entomologiæ, Flensburgi et Lipsiæ, 1775, p. 296.

Cymothoa paradoxa, Fabricius, Entomologia Systematica, Hafniæ, 1792–98, Suppl., p. 304, and t. ii. p. 503.

Serolis fabricii, Leach, Dict. d. Sci. Nat., 1818, t. xii. p. 340.

Serolis orbignyi, Audouin and Milne-Edwards, Arch. d. Mus. d' Hist. Nat., 1841, t. ii. p. 25.

Serolis orbigniana, Milne-Edwards, Hist. Nat. d. Crust., vol. iii. p. 232.

Serolis paradoxa, Miers, Crustacea collected during Survey of H.M.S. "Alert," Proc. Zool. Soc. Lond., 1881, p. 61.

Serolis paradoxa is the type species upon which the genus *Serolis* was founded by Leach. The animal was first obtained on the shores of Patagonia by Sir Joseph Banks at the close of the last century, and these specimens were described by Fabricius as *Oniscus paradoxus;* in a subsequent work Fabricius altered the name to *Cymothoa paradoxa.* In the twelfth volume of the Dictionnaire des Sciences Naturelles, Leach gave some account of this species which he termed "*Serolis fabricii.*" The first full description of the species is contained in the memoir of Audouin and Milne-Edwards,[2] and subsequently Grube[3] in his important Monograph gave a fuller account of this same species, but under the name of *Serolis orbigniana.* In a short note published in the Journal of the Godeffroy Museum,[4] Schmeltz called attention to the identity of *Serolis fabricii* with another species described by Audouin and Milne-Edwards under the name of *Serolis orbignyi.* More recently Miers, in his account of the Crustacea collected during the voyage of the "Alert," has also pointed out the identity of these two species.

[1] *Proc. Calif. Acad. Nat. Sci.*, vol. vii. p. 36.
[2] *Loc. cit.*, p. 25.
[3] *Loc. cit.*, p. 225.
[4] Part xii. p. 161.

I have little doubt that both Schmeltz and Miers are quite right in regarding these two species as identical; it is impossible, either from the description or the figures contained in the memoir of Audouin and Milne-Edwards, to select any characters by which the two species *Serolis fabricii* and *Serolis orbigniana* can be definitely distinguished; such differences as there are appear to me to arise from the fact that the two "species" are in reality merely the males and females of the same species, *Serolis fabricii*.

With regard to the name I have followed Miers and written *Serolis paradoxa;* this name evidently has the priority.

A number of specimens of *Serolis paradoxa* were dredged by the Challenger at the Falkland Islands, and this, together with the adjacent shores of Patagonia, is the only locality which the species is known with certainty to inhabit. According to Leach, *Serolis paradoxa* extends to the west coast of Africa; he makes the following remarks about its distribution (*loc. cit.*, p. 340)—"I have only seen two specimens; one is in the collection of Banks and comes from Tierra del Fuego; the other is in my possession and was given me by Dufresne, who tells me that he received it from Senegal." The specimen from Senegal is now in the British Museum, and is labelled in the handwriting of Leach. The British Museum contains another specimen of *Serolis paradoxa* which is labelled "New Zealand," but I believe that in this case, as in that of *Serolis schythei* to be mentioned later, the locality is not thoroughly authenticated. Miers includes *Serolis paradoxa* in his list of New Zealand Crustacea apparently on the authority of this same specimen.

The males and females of this species are not distinguishable by any well marked difference of size; the males are, however, a little broader proportionately, as is shown by the following measurements taken from two of the largest specimens obtained by the Challenger.

	Length.	Breadth.
Male, ...	24·5 mm.	25 mm.
Female, ...	27·5 „	26 „

The form of the abdominal sterna differs in the two sexes; in the male the outline is somewhat crescentic, the posterior margin being curved and the anterior margin almost straight; in the female each of these segments bears a median spine upon the posterior margin directed backwards and closely overlapping the succeeding segment. In this character *Serolis paradoxa* agrees with *Serolis schythei*, but the spines in the females are longer than in that species. The above measurements do not express the greatest size to which this species attains; there are several specimens in the British Museum somewhat larger, and White states[1] that individuals have been known to reach the great length of 6 inches! This last statement, however, requires confirmation.

Serolis paradoxa is, as Grube remarks,[2] more nearly allied to *Serolis schythei* than to

[1] White, Description of New Species of Insects and other Annulosa, *Ann. and Mag. Nat. Hist.*, 1843, vol. xii. p. 366.
[2] *Loc. cit.*, p. 225.

any other species, but it can easily be distinguished by the smaller epimera and by the shape of the caudal shield, which is more triangular than in that species; as in *Serolis schythei*, the caudal shield is traversed by three longitudinal carinæ, and there is a stout spine close to its anterior border in the middle line; another carina runs parallel to the anterior margin of the caudal shield, of which traces exist in *Serolis schythei*. The transverse ridge of the latter is not found in *Serolis paradoxa*. As in *Serolis schythei*, the first four free thoracic segments have their epimera separated from the terga by a distinct suture.

The antero-lateral areas of the cephalic shield are more extensively developed in *Serolis paradoxa*, so that the breadth of the anterior portion considerably exceeds that of the posterior portion, while in *Serolis schythei* the transverse diameter of the cephalic shield is greatest at about the level of the eyes.

Antennæ.—The filament of the second pair of antennæ in both the male and female is furnished with a series of short recurved hooks; these hooks are not found upon all the joints of the filament, they commence to be visible (in one specimen) on the seventh, and extend as far as the sixteenth; in the last nine or ten of these joints there is a continuous row on the upper surface not far from the inner margin, commencing close to the posterior articulation and extending in a straight line up to the anterior articulation, the row of hooks then bends inwards and follows closely the anterior edge of the joint, terminating at its outer extremity; in the anterior joints the hooks gradually decrease in number until in the seventh joint there is only a short row on the anterior margin.

Similar structures are found in other species (*e.g.*, *Serolis bromleyana*, *Serolis gracilis*, *Serolis septemcarinata*, *Serolis schythei*), though in no case are the hooks so large and conspicuous as in *Serolis paradoxa*.

The inner lobe of the *first maxillæ* is nearly half the length of the outer lobe; it consists (Pl. V. fig. 14) of a straight and narrow stem and an oval wider distal portion furnished with a single spine near the lower border.

The *second pair of maxillæ* has, as in all other species, two smaller anterior lobes and a larger posterior one; the anterior lobe is a trifle smaller than the second, and bears at its free extremity two long spines; the second lobe has five or six, while the largest posterior lobe has some twenty or thirty.

The *maxillipedes* are characterised by the almost square outline of the stipes, which is quite twice the breadth of the lamina; the latter is clothed on the inner surface with fine hairs; the suture which separates it from the stipes is not complete posteriorly.

The *third pair of thoracic appendages* in the male (fig. 13) are very much like those of *Serolis neœra;* the second, third, and fourth joints are furnished with abundant plumose hairs arranged in two rows, one above the other; the upper row spring from a strong ridge which runs at a short distance from the inner margin of these three

joints, while the second row appears to be attached along the inner margin itself; the penultimate joint is swollen and pear-shaped, broader at the base than above; along the inner margin are some fifteen pairs of long cylindrical spines, which are of a rather unusual form; the distal third bears two rows of short cylindrical branches; the centre of the spine appears to be hollow at the base, and the bounding membrane is continued above into a solid axial rod, which projects for a short way beyond the anterior extremity of the spine. This appendage and the peculiar spines upon the penultimate joint are figured by Grube (*loc. cit.*, pl. v. figs. 3, 3, *a*), Grube also states that the spines upon this pair of appendages are alike in both males and females:—"Der Innenrand des 2ten Paares Greiffüsse trägt lange an der Vorderseite gesägte Stacheln, sowohl beim Männchen als beim Weibchen." They are in reality quite different in the female; the fourth joint bears a row of spines arranged in pairs; on the distal half of the joint these spines are strong and serrated along both margins, resembling entirely the serrated spines found upon the other thoracic limbs; posteriorly the serrations become less marked, and the proximal end of the joint has only smooth sword-like spines, the third and fourth joints have none of the soft plumose hairs that are found in the males; their place is occupied by tufts of strong spines, some of which are serrated. In this as in all other species in which the males have the peculiarity here described, the females are invariably different, the third pair of thoracic appendages being in this respect closely similar to the succeeding appendages.

The remaining thoracic appendages are not in any way remarkable. The second joint, which is rather smaller than the first joint, is furnished with a tuft of long hairs upon the inner surface at the distal extremity, among which are a few serrated spines; the succeeding joints, which are approximately of this arm length, the fourth being rather the longest, have a tuft of hairs in the same position, among which are a greater number of serrated spines; in the penultimate joint the long delicate hairs are almost entirely absent, their place being taken by stout spines, many of which are serrated. Along the outer margin of the joints, with the exception of the first, are tufts of short spines, very few of which are serrated.

The three anterior *abdominal appendages*, like those of *Serolis schythei*, have no plumose hairs upon the basal joint.

The suture of the *operculum* is oblique.

The exopodite of the fifth pair of abdominal appendages is bifurcate.

Station 316, February 3, 1876; lat. 51° 32′ S., long. 58° 6′ W.; 4 fathoms; bottom, mud.

2. *Serolis convexa*, Cunningham (Pl. VI. figs. 9–15).

Serolis convexa, Cunningham, Crustacea, &c., of H.M.S. "Nassau," Trans. Linn. Soc. Lond., vol. xxvii. p. 498, 1871.

Serolis convexa, Studer, Isopoden gesammelt, &c., Abhandl. d. k. Akad. d. Wiss. Berlin, 1882, p. 9 (separat Abdrück).

The Challenger obtained only a single specimen of this species, from Port William, Falkland Islands; I have, however, had the opportunity of comparing it with four other specimens in the British Museum which are the types.

Prof. Cunningham's description (*loc. cit.*, p. 498) is as follows:—"Most nearly allied in form to *Serolis planus*, Dana. Body very convex, much more so than in any other species of the genus with which I am acquainted. A prominent carina along the mesial line. Two last segments of pereion distinctly narrower than those which precede them. Last segment of pleon more elongated than in *Serolis planus*, and possessing three well-marked ridges—a median, interrupted in the middle, and two lateral, each terminating in a sharp point. Eyes very prominent, and placed rather near to each other."

Two specimens were obtained by Prof. Cunningham on the north coast of Fuegia.

Prof. Studer has also published some notes upon this species in his account of the Isopoda collected during the voyage of the "Gazelle," and he has pointed out that the chief character by which Grube distinguished *Serolis convexa* from *Serolis gaudichaudii*, viz., a tuft of hairs upon the antepenultimate joint of the second thoracic appendages, is really a secondary sexual character peculiar to the males not only of *Serolis convexa* but also of *Serolis gaudichaudii*; before Prof. Studer's paper came into my hands I had noted the same fact, and alluded to it briefly in my Preliminary Report;[1] the specimen dredged by the Challenger is a male, and it shows another character which I believe to be peculiar to the males; on the sterna of the last three thoracic segments is a small patch about 2 mm. in length by 1 mm. in breadth, distinguishable by its velvety appearance and darker colour from the surrounding integument; this on microscopic examination proved to be covered by a multitude of hairs exactly similar to those found upon the second thoracic appendages, only rather shorter; some of the segments in front also, especially the second, have a small tuft of these hairs.

In other respects the males and females of this species do not differ greatly in appearance; the males are imperceptibly broader in proportion to their length than the females, as shown by the following measurement taken from the male in the Challenger collection and the single female specimen in the British Museum:—

	Length.	Breadth.
Male, ...	25 mm.	20 mm.
Female, ...	25 „	19 „

The sterna of the *abdominal segments* present no differences in the two sexes.

[1] *Proc. Zool. Soc. Lond.*, pt. iii., 1884, p. 330.

The suture dividing the outer lamella of the *opercula* is accurately at right angles to the long axis of the body in the female; it is more oblique, slanting downwards in all the male specimens that I have seen; I am inclined, however, to think that this is rather an individual variation than a mark of sex, inasmuch as nothing of the kind exists in any other species.

Serolis convexa has been figured by Cunningham[1] and by Studer,[2] and as both these figures, especially the latter, show plainly the characters of the species, I hardly think it worth while to introduce another into the present Report.

Serolis convexa can be easily distinguished from *Serolis gaudichaudii* by a number of small characters; the shape of the body is more oval in *Serolis gaudichaudii*; in *Serolis convexa* it is more pear-shaped, owing to the greater length of the caudal shield, which terminates in a more pointed extremity; in both species there is a central and two lateral carinæ; the latter are curved, and follow closely the lateral margin of the caudal shield but at some distance from it; in *Serolis gaudichaudii* these carinæ, especially the two lateral ones, are very faint; in *Serolis convexa* the lateral carinæ are strongly marked, and terminate more or less abruptly in a short spiniform projection at the end of the middle third of the caudal shield; the median carina is only found in the anterior part of the caudal shield, posteriorly it becomes obsolete; another difference between the two species is in the colour, and since this difference is quite constant in all the specimens examined by me (five of *Serolis convexa*, four of *Serolis gaudichaudii*) it is worth noting; *Serolis gaudichaudii* is distinguished by its dark brown colour, darker in the central part of the body, and dotted all over with black spots of various sizes; in *Serolis convexa* the colour is of a uniform pale brown, hardly darker in the middle of the body than upon the epimera. This description of course relates only to specimens preserved in alcohol. Another species closely allied to *Serolis convexa* is Dana's *Serolis plana*, and from a careful comparison of the figures and descriptions given of these two species I find it almost impossible satisfactorily to separate them. The general shape of the body, the form of the epimera, &c., is almost identical in the two. The eyes, however, of *Serolis plana* are stated by Dana to be conical in shape, whereas those of *Serolis convexa*, as in all other species, are distinctly reniform. In *Serolis plana* "the articulation of opercular plates is more nearly transverse than in *Serolis gaudichaudii*;" there is also a lateral tooth on the caudal shield just below termination of carina; the median carina is obsolete posteriorly, and the fourth segment has a low prominence just inside of the epimeral suture. The first character is, as I have already shown, of no use in distinguishing the species; the last character, namely, the presence of a low prominence to the inside of the epimeral suture of the fourth segment, is well marked in the Challenger specimen of *Serolis convexa*; in this specimen all the thoracic segments have a slight prominence, almost indistinguishable in the anterior and posterior ones, but conspicuous in the fourth segment, where it slightly

[1] *Loc. cit.*, pl. lix. fig. 3.

[2] Isopoden gesammelt, &c., *loc. cit.*, Taf. i. figs. 1*a*, 1*b*.

overlaps the succeeding segment and recalls *Serolis minuta*, in which species (see below p. 77) all those prominences are highly developed and project backwards as flat conical processes over the following segments.

The presence of a distinct lateral tooth below the termination of the carinæ does seem to distinguish *Serolis plana* from *Serolis convexa* where there is no such tooth, but it would not be safe, I think, for the present to separate the two until a larger number of specimens of both have been examined.

In all the three species—*Serolis gaudichaudii*, *Serolis convexa*, and *Serolis plana*—the epimera of the second, third, and fourth pairs only are separated from the terga by a distinct suture; in the first two species the anterior epimera are divided by a transverse suture as in so many other species; this suture is, however, not very well marked, and in the specimen of *Serolis convexa* obtained by the Challenger I could not detect any trace of it, though it was distinctly visible in the British Museum specimens.

Appendages.—I give here a somewhat full description of the appendages which have not been described by Cunningham.

Antennæ.—The posterior pair of antennæ are decidedly longer than the anterior pair, reaching as far as the end of the first epimera.

Of the *anterior pair*, the first joint is somewhat broad and quadrangular, the second joint is narrower and a little longer; the anterior and posterior surface of both are covered by a few scattered hairs; the third joint is a cylindrical rod somewhat bow-shaped, and only slightly longer than the preceding joint; the fourth joint is short, about one quarter as long as the third. The filament appear to consist of about twenty-five joints, and each joint has two sensory hairs, one situated near the anterior extremity of the joint, the other near its posterior extremity.

The *posterior pair* of antennæ consist as usual of five joints and a filament.

The first joint is the shortest, the second a little longer and somewhat hour-glass shaped. The third, as usual, inserted in a wedge-like fashion between the second and the fourth; the fourth joint is the longest of the whole appendage, is somewhat bent, and a ridge parallel with the curved lower margin runs along its whole length; the joint narrows towards its extremity, where it articulates with the terminal joint, which is a little shorter and more uniformly cylindrical in shape; the upper margin of the two last joints is furnished with scattered tufts of hairs. The filament has twenty-one joints, which increase in length but diminish in thickness towards its extremity.

The *mandibles* have the cutting edge prolonged posteriorly into two subequal conical teeth; on the upper side are two spines situated one behind the other, the anterior one rather longer and broader.

The *first maxillæ* are in no way remarkable.

The *second maxillæ* (Pl. VI. fig. 14) differ from those of most other species in that the two anterior lobes are not much smaller than the posterior, and are furnished on the outer

edge with eight or nine hairs instead of the usual two. In this respect *Serolis gaudichaudii* seems to resemble *Serolis convexa* (*cf.* Audouin and Milne-Edwards, *loc. cit.*, pl. i. fig. 11).

The *maxillipedes* (fig. 15) are of the usual shape; the lamina is furnished with a number of long hairs upon the lower surface, and the second joint of the palp has a row of similar hairs upon the lower surface, some way from the external margin, which, as usual, has another row of hairs. The third joint of the palp is extremely small, and I was at first inclined to think that this was a mere accident, and that the terminal joint of the palp had been recently broken off, but since Milne-Edwards and Audouin figure[1] the same condition in *Serolis gaudichaudii*, it appears to be characteristic of these two species.

The *second pair of thoracic appendages* are figured on Pl. VI. fig. 10; the tuft of hairs (a) have already been noticed as peculiar to the males; several of the spines forming the inner surface of the penultimate joint are more highly magnified in fig. 11; the longer spines, instead of being bifurcate, as is the rule, terminate in a gradually narrowing extremity, the posterior margin of which is beset with a dense row of fine branches.

The *third pair of thoracic appendages* of the male are shown in Pl. VI. fig. 9; the terminal joint is comparatively narrow; from the inner margin arise some eight pairs of conical spines, the axis of which projects beyond the termination as a short filamentous recurved process.

The remaining thoracic appendages were all more or less damaged, with the exception of the sixth, which is figured on Pl. VI. fig. 12; the second, third, fourth, and fifth joints of this appendage are each furnished on the inner side with a tuft of fine pinnate hairs like those on the second pair of appendages in the male; on the distal border of the fourth joint is a row of sharp serrated spines; the terminal claw-like joint of the appendage is sharply bent upon itself at right angles; in *Serolis gracilis* and other species those appendages in the males are similarly modified.

In the *anterior abdominal appendages* the basal joint is triangular in shape, and the projecting (lower) angle is furnished with three plumose hairs in the first of these appendages, and two in the second and third as in many other species.

The *opercula* are traversed by a suture at right angles to the long axis.

Port William. Falkland Islands, 5 to 12 fathoms.

3. *Serolis schythei*, Lütken (Pl. II. figs. 5–13).

Serolis schythei, Lütken, Vidensk. Meddel. f. d. nat. Foren. i Kjøbenhavn, 1858, p. 98, Tab. i. figs. 12, 13.

Serolis schythei, Grube, Archiv f. Naturgesch., 1875, p. 220, pl. v. fig. 1, pl. vi. fig. 1.

This species was originally described from a male specimen by Lütken. Grube in his Monograph of the genus added some details to Lütken's description, and pointed out the differences that exist between the males and the females.

[1] *Tab. cit.*, figs. 12, 13.

The Challenger obtained a great number of specimens of *Serolis schythei*, ranging from the Gulf of Peñas on the north, to the Falkland Islands on the south.

The collection of Crustacea in the British Museum contains one specimen which is labelled "New Zealand," but I believe that it is not quite certain whether this label be correct. With this possible exception, *Serolis schythei* is confined to the shores of Patagonia and the Falkland Islands.

The males of *Serolis schythei* differ from the females by their greater proportional and actual breadth; the largest female specimen in the Challenger collection measures 32 mm. in length by 32 mm. in greatest breadth, the largest male specimen measures 30 mm. in length by 38 mm. in breadth. The greater breadth of the males is owing to the greater length of the epimera. The sixth epimeron in this male specimen measures 17 mm. in length, and extends for the space of about 5 mm. behind the extremity of the caudal shield; in the female these epimera only measure 13 mm., and terminate just beyond the end of the caudal shield. The first abdominal epimera also are longer in the male than in the female; the two sexes also differ, like many other species, in the shape of the abdominal sterna. A third difference is to be found in the antennæ, which are described below.

The colour of *Serolis schythei* (in alcohol) is pale brown, becoming darker in the middle of the body, and diversified with dark brown or black spots, which vary considerably in their number and size in different specimens.

The *cephalic shield* is not unlike that of *Serolis cornuta*, but the prominences and ridges upon its surface are less developed; there is a slight ridge dividing the antero-lateral portions from the rest; to the inside of and behind the eyes are two prominences somewhat triangular in form, which correspond to those in *Serolis cornuta*, but are directed more inwards; between the two is a triangular area which forms the posterior boundary, and owing to the comparatively slight development of the lateral tubercles, lies almost on the same level with them; the disposition of these three prominences is also like what occurs in *Serolis neæra*, which in other respects shows considerable resemblances to this species. The eyes are very large and prominent.

Thorax.—The thoracic epimera are flat and sickle-shaped; as in *Serolis cornuta* the external half of all the epimera projects freely; the articular processes upon the epimera are, however, entirely absent. The first epimera are divided by a transverse ridge. While in the majority of species only the three anterior of the free thoracic segments are divided by a distinct suture into a tergal and an epimeral portion, in *Serolis schythei* there is also a suture separating the terga and epimera of the fourth segment. The posterior margin of the tergum of each segment, with the exception of the first, is curved backwards in the middle line into a short spine; these gradually diminish in size from before backwards; the antero-posterior diameter of the first free thoracic segment is a little less than that of the succeeding segment, which is the largest, and measures 3 mm. in the

female and 2 mm. in the male; the third segment is a little smaller than the second in the female and about the same size in the male; the two last thoracic segments are nearly the same size, the anterior being a trifle the larger, and measuring about one half the diameter of the preceding segment.

On the under surface the sterna of the first two thoracic segments are, as in all other species, divided by sutures into three portions, which resemble in every particular those of *Serolis cornuta;* the posterior thoracic segments are not so fused together as they often are; the sixth is quite distinct from the following ones, and is not divided into a central piece and two wedge-shaped lateral pieces as it is in *Serolis neœra* and other species; a deep groove separates the seventh from the eighth, but it does not extend as far as the suture which marks the boundary between the epimera and sterna.

Abdomen.—The first abdominal epimera are long, and reach beyond the end of the caudal shield in the male, in the female they do not reach quite so far as the end of the caudal shield; the second epimera are short, as in *Serolis neœra*, and only extend for a very short distance down the lateral margin of the caudal shield; they are not distinctly longer in the male than in the female.

The sterna of the abdominal segments differ in the two sexes as already said; in the male the posterior margin is straight, and the two ends project backwards as short spines; the third segment has, in addition, a short median spine; in the female the median portion of all three is produced into a short broad spine.

The *caudal shield* is hexagonal in outline; the posterior end projects as a short spine; there is a distinct median keel and two lateral keels which start from the base of a strong blunt spine situated in the middle line at the anterior end, and terminate in two short spines placed some way in front of the attachment of the uropoda; a transverse ridge, which is prolonged backwards into three short spines, of which the median larger one is upon the longitudinal carina, traverses the caudal shield; viewed in profile, the caudal shield appears to consist of two portions bounded by this transverse ridge; the anterior part, which possibly corresponds to the three fused terminal segments of the body, overlaps the posterior portion or telson; on the other hand it is possible, as suggested by Studer, that the two obliquely running longitudinal keels mark the boundary between the terminal segment of the body and the telson.

The two pairs of *antennæ* are of about the same length. The anterior pair have a short proximal joint with fine hairs upon the upper surface; the two succeeding joints are elongated and somewhat curved; the posterior surface is furnished with fine hairs; the fourth joint is short and oval; the filament is made up of about twenty-three joints, of which the proximal ones are short, but gradually increase in length towards the distal extremity. The second pair of antennæ consist, as usual, of five joints and a terminal filament; the joints increase in length towards the distal end of the antennæ, the last joint being the longest and considerably narrower than the rest, which are about

equal in diameter; the three last joints are beset with hairs arranged in tufts or scattered singly over the surface; the filament is made up of from fifteen to seventeen joints, which, like those of the anterior antennæ, increase in length and diminish in width towards the free extremity; the inner side of each joint, just before the attachment of the joint in front, has a tuft of fine hairs; the anterior margin of the middle joints has a series of short curved spines like those already described in *Serolis paradoxa* (*ante*, p. 35); the antennæ of the males possess a series of delicate lamellar processes (Pl. II. fig. 6) arranged in a single line along the inner side of most of the joints, being absent only from a few of the extreme distal and proximal joints; these structures, which are very probably sensory, take the form of oblong lamellæ with rounded angles, those at the anterior part of the joint are larger and somewhat fan shaped; their surface is marked by a series of grooves radiating outwards from the base of attachment.

The *mandibles* (Pl. II. figs. 12, 13) are markedly asymmetrical, as in other species.

The *maxillæ* present no peculiarities.

In the *maxillipedes* (fig. 10) the stipes and the lamina are not separated by a suture; both are covered with scattered hairs, and a row of finer hairs clothes the inner margin of the latter; at the summit of the terminal joint of the palp is a small protuberance carrying three stoutish hairs similar to those upon this and the preceding joint.

The *first pair of ambulatory appendages* are figured by Grube in his Monograph, but the hairs on the inner side of the penultimate joint are not quite correctly shown; the longer spines (Pl. II. fig. 7) terminate in two flat lateral expansions, and the axis of the spine is continued into the posterior and longer of the two.

The *second pair of ambulatory appendages* of the male (Pl. II. fig. 8) are modified in the usual way (*ante*, p. 13).

In the *remaining thoracic appendages* (fig. 9) the two first joints are subequal in length; the third joint is about half the length of the second, the fourth slightly longer, the fifth shorter than the fourth, and approximately of the same size as the second; the terminal joint is more bent and hook-like in the last pair of appendages than in any of the others. The second joint (in the males only) has a series of about fifteen tubercles close to the inner margin; the third, fourth, and fifth joints are furnished with numerous long and slender hairs as well as stouter sword-like and serrated spines arranged in tufts in the usual way; the last pair of appendages in the male are distinguished from the rest by a greater development of hairs upon the inner surface of the terminal joints; this is an approximation to the marked difference that these appendages show in other species (*e.g.*, *Serolis gracilis*). In *Serolis schythei*, however, these hairs are not, as in the above-mentioned species, in any way different from those upon the rest of the ambulatory limbs.

The *three anterior abdominal appendages* are characterised by the absence of

branched hairs upon the basal joint; in this they agree with *Serolis paradoxa* and the Australian species of the genus.

The *opercula* have the exopodite divided by an oblique suture.

The exopodite of the *gill appendage* is bifurcate.

The *uropoda* are attached close to the termination of the caudal shield, and extend a little way beyond it; they are comparatively large and foliaceous, and furnished with numerous branched hairs.

Station 304, December 31, 1875; lat. 46° 53′ S., long. 75° 12′ W.; 45 fathoms; bottom, green sand.

Station 313, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; 55 fathoms; bottom, sand.

Station 314, January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; 70 fathoms; bottom, sand.

Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; 12 fathoms; bottom, sand, gravel.

Station 316, February 3, 1876; lat. 51° 32′ S., long. 58° 6′ W.; 4 fathoms; bottom, mud.

4. *Serolis latifrons*, White (Pl. II. figs. 1–4).

Serolis latifrons, White, List Crust. Brit. Mus., 1847, p. 106.
Serolis latifrons, Miers, E. J., Ann. and Mag. Nat. Hist., 1875, p. 74.
Serolis latifrons, Miers, E. J., Cat. New Zealand Crust., 1876, p. 117.
Serolis latifrons, Smith, Bull. U. S. Nat. Mus., 1876, vol. iii. p. 63.
Serolis latifrons, Miers, E. J., Phil. Trans., 1879, extra vol., p. 204.
Serolis latifrons, Studer, Th., Archiv f. Naturgesch., 1879, p. 26.

This species was named and described by White from specimens obtained during the voyage of the "Erebus" and "Terror"; one of these specimens is preserved in the British Museum, and was dredged at Rendezvous Cove, Auckland Islands. Miers first described the species from specimens, brought home by the Transit of Venus Expedition from Kerguelen Island, and a more detailed description of the same species is to be found in Studer's Beiträge zur Kenntniss niederer Thiere von Kerguelensland.[1]

A number of specimens were dredged by the Challenger at Christmas Harbour, Kerguelen, 25 fathoms, and two others which present some differences from the typical form were dredged in deeper water (210 fathoms) off Possession Island.

Without entering into any systematic description of this species, which has already been sufficiently done by the above mentioned authors, I may add here a few details.

Studer describes the largest specimens as attaining a length of 40 mm. and a breadth of 30 mm.; these are evidently females, which he says are 1 to 2 mm. less than the

[1] *Archiv f. Naturgesch., loc. cit.*, p. 26.

males. In the Challenger collection the two largest specimens measure 32 mm. in length by 24 mm. in breadth, and are females with developed brood lamellæ. The males are proportionately broader than the females; the length of the largest specimen is 28 mm., its breadth 24 mm.; in one specimen only the breadth was proportionately less than in all the rest, 28 mm. in length by 22 mm. in breadth; the sterna of the free abdominal segments differ but slightly in the two sexes—in the females all have a short, broad, median spine, in the males the two posterior segments are provided with such a spine, which is if anything rather smaller than in the female.

The colour of *Serolis latifrons* (in alcohol) is a dark bluish brown, becoming lighter brown upon the epimera; a very characteristic mark of the species is a white spot upon the anterior part of the cephalic shield, just behind the rostrum; the fifth pair of epimera also are generally lighter in colour than the rest of the body.

The six posterior thoracic epimera are separated from the terga by a distinct suture and the first abdominal segment, which in no other species of *Serolis* known to me has any trace of epimera, has distinct though very minute epimera separated from the tergum by a suture which is continuous with that dividing the epimeron and tergum of the segment in front.

Appendages.—The second pair of antennæ are longer than the first pair; the latter have as usual four joints; the fourth joint is extremely short, its length being only one-third of its breadth; the filament has sixteen joints; in the second pair of antennæ the terminal joint (Pl. II. fig. 4) is prolonged on the ventral side into a process which extends as far as the third joint of the filament; the filament has twelve joints.

The *mandibles* are characterised by the great length of the narrow distal half, which is about half the length of the entire appendage; the masticatory portion of the two mandibles are shown on Pl. II. figs. 2, 3; they present the usual unsymmetrical disposition of the laminæ and spines upon the lower surface.

The *first pair of maxillæ* resemble the same appendages in other species, but the second joint of the palp has seven or eight spines upon its extremity instead of two.

The *second maxillæ* present no differences from other species.

Maxillipedes.—The *lamina* and *stipes* are separated by a complete suture; the outer margin of the stipes and cardo is clothed with fine delicate hairs; the lamina is furnished on its under surface with a number of long hairs which extend over the proximal joint of the palp.

The *first ambulatory limb* presents no special differences from that of other species.

Of the *second pair* in the male, the penultimate joint is rather narrow, only slightly wider where it articulates with the preceding joint; the distal joint terminates in a spine-like extremity which is separated by a suture; just behind the articulation of this spine is a ridge bearing a row of fine hairs. The remaining joints of this limb are almost smooth, and have only a few short hairs.

The *remaining thoracic appendages*, on the contrary, are abundantly furnished with long, unbranched hairs, and short, stout, serrated, and smooth spines; the latter are especially developed at the distal extremity of each joint just before its articulation with the succeeding joint.

The proximal joint of the limb is the stoutest, and except in the two penultimate limbs, the longest, its margin is clothed with fine delicate unbranched hairs; the second joint is shorter, and the third shorter still; the fourth and fifth joints in the posterior limbs are considerably elongated; the distal extremity of the terminal joint is separated off by a suture, and ends in a sharp spine.

The *abdominal appendages* present no peculiarities except the terminal uropoda, which have been well described and figured by Studer;[1] the endopodite becomes fused with the protopodite, and is extraordinarily elongated; the short exopodite is spine-like, and can be fixed at right angles to the rest of the appendage, forming in this way a defensive apparatus, which, as Studer suggests, no doubt secures to the animal a greater freedom from the attacks of birds and other enemies. For figures and fuller description of this structure the above-mentioned Memoir by Studer should be consulted. The structure of the uropoda in this species recalls that characteristic of the family Sphæromidæ.

Two specimens of *Serolis latifrons* dredged off Possession Island in 210 fathoms present some variations from all the other specimens; they are both females, with fully developed brood lamellæ, and are approximately of the same size, measuring 28 mm. in length by 23 mm. in breadth; the proportions therefore of these specimens are nearly the same as in the males of the typical Kerguelen form; the sterna of the abdominal segments, however, are quite like those in the females. In one specimen the posterior two pairs of brood lamellæ of the left side overlap those of the right, the two anterior pairs are normal. This variety is quite different in colour, being of a uniform yellowish brown, with a few scattered black spots, especially upon the caudal shield. The shape of the caudal shield is different from that in the Kerguelen specimens; it is considerably narrower, and the lateral margins are almost straight, with only a very slight outward bulging; the posterior epimera of the body come therefore to project considerably beyond the margin of the caudal shield, which is almost completely triangular in shape.

One of the specimens is figured on Pl. II. fig. 1, and may be compared with the figures of Studer and Miers of the normal variety.

Station 148, January 3, 1874; lat. 46° 47′ S., long. 51° 37′ E.; 210 fathoms; bottom, hard ground, gravel, shells.

Kerguelen Island, January 13, 1874; Cascade Bay, 5–40 fathoms. January 17, 1874; Royal Sound, 25 fathoms.

[1] *Archiv f. Naturgesch.*, 1879.

5. *Serolis septemcarinata*, Miers (Pls., II. fig. 14, VIII. figs. 3–5).

Serolis quadricarinata, White, List Crust. Brit. Mus., 1847, p. 106.
Serolis septemcarinata, Miers, Ann. and Mag. Nat. Hist., 1875, p. 116.
Serolis septemcarinata,[1] Miers, Phil. Trans., 1879 (extra vol.), p. 206.
Serolis ovalis, Studer, Archiv f. Naturgesch., 1879, p. 24.

That *Serolis septemcarinata* is the same species as *Serolis ovalis* cannot be doubted; the descriptions and figures given by Miers and Studer agree in every detail.

Both these observers described the species from a single specimen only; Studer's description relates to a female specimen from Kerguelen, while Miers's specimen was dredged at the Crozets.

The Challenger obtained this species at Kerguelen, and also off Prince Edward's Island; the species therefore is common to these three groups of Antarctic Islands, but has not as yet been obtained elsewhere.

Studer remarks the rarity of this species as compared with *Serolis latifrons*, and suggests that the absence of the spine-like uropoda found in *Serolis latifrons* may render it an easier prey to its enemies; the Challenger, however, collected a large number of specimens of this species at Kerguelen, very nearly as many as of *Serolis latifrons*.

The males of this species differ from the females by their greater size.

The largest male specimen measures 13 mm. in length by 11 mm. in breadth, the largest female specimen measures 11 mm. in length by 9 mm. in breadth. All the specimens obtained by the Challenger, with the exception of a few newly hatched young, are almost exactly the same size as the two specimens from which the measurements are taken, and the superiority in size of the males over the females can therefore be very plainly seen.

The abdominal epimera are similar in both sexes.

A noticeable difference between the two sexes is to be found in the first thoracic epimera; the under surface of these epimera in the males is furnished with a row of ridge-like tubercles, six or seven on either side, which are situated just external to the attachment of the appendages; they are arranged in a semicircle, with the convexity directed forwards and outwards; in the female there is no trace of any such structure; it is probable that these tubercles assist the male in maintaining a firm hold of the female during copulation.

The general surface of the body, especially the epimera, is sculptured, the latter are traversed by innumerable ridges anastomosing with each other; on the cephalic shield and the tergal portion of the segments the surface is covered by minute scattered pits. All the epimera, with the exception of the first, are traversed by a crescentic ridge which

[1] In my opinion the catalogue name *Serolis quadricarinata* ought not to have been changed by Miers in spite of its being a "*nomen ineptum*," but since the actual description of the species is under the name of *Serolis septemcarinata*, it is necessary to adopt it here.

follows at some distance the anterior margin of the segment; the first epimera are not divided by any transverse suture; the epimera of the three succeeding segments are separated from their terga by a suture.

The *cephalic shield* has a crescentic ridge between and a little in front of the eyes as in *Serolis tuberculata* (*cf.* Pl. VI. fig. 1) and other species; its anterior margin is prolonged in the median line into a short rostrum, and as in other species a ridge separates off the antero-lateral portion from the rest.

The *caudal shield* is trifid at its extremity, and furnished with a central carina which runs from end to end; on either side of this are two lateral carinæ, which do not extend along the whole length of the caudal shield, they terminate behind at some distance from the end of the caudal shield in freely projecting spines; the inner pair extend farther back than the outer pair; another carina runs parallel with the anterior margin of the caudal shield on either side, and terminates close to the articulation of the uropoda. The lateral margins of the caudal shield, as well as of the posterior epimera, are denticulate. A noticeable character of this species is the prolongation of the abdominal epimera a little way beyond the last pair of thoracic epimera; in *Serolis minuta* the same thing occurs, but in these two species only.

The *first pair of antennæ* are a little shorter than the second pair; the filament, which has about eighteen joints, is rather longer than the basal portion of the antenna,—the latter is composed of four joints; the first is short, the second about twice its length, and about equal in length to the succeeding joint, though considerably stouter than it.

In the *second pair of antennæ* the two distal joints of the stem are the longest, and about equal in length to each other; they are somewhat bow-shaped, and the anterior margin is beset with tufts of long hairs, five to each joint in the specimen from which the description is taken; the filament has twelve or thirteen joints.

The *mandibles* show the usual asymmetry; the left mandible has a chisel-like cutting process, the edge of which is somewhat crenate in outline; this structure is absent from the right mandible.

The *first pair of maxillæ* consist as usual of a basal piece with which are articulated two masticatory lobes; the posterior of these is delicate and small, and bears one short spine at its expanded distal extremity as in *Serolis paradoxa* (*cf.* Pl. V. fig. 14).

The *second pair of maxillæ* are comparatively large; the middle lobe is furnished with four spines upon the cutting margin instead of the usual two.

In the *maxillipedes* the stipes and lamina are completely separated by a suture; the second joint of the palp is not so markedly heart-shaped as in other species.

In the *second pair of thoracic appendages* the sixth joint is entire; the fifth joint has a row of spines upon the inner side, they are as usual of two kinds; the longer spines terminate in a bifid extremity, of which the anterior bifurcation is the longest; the axis of the spine extends between the two branches, and is rather longer than either.

One of the *third pair of thoracic appendages* in the male is displayed in fig. 3; the spines peculiar to this limb are confined to the projecting lower angle of the penultimate joint; several of these are shown more highly magnified in fig. 5.

The remaining thoracic limbs present no features of interest.

The *third pair of appendages* in the male (Pl. VIII. fig. 3) is rather different from the same appendages in other species; the penultimate joint is comparatively long and narrow, but widens out in its posterior fourth, where six spines are attached in pairs; at the upper end, close to its articulation with the terminal joint, is a single pair of spines; the interval between this spine and the six at the hinder end of the joint is beset with a few scattered hairs; the posterior spines are broad and conical, and the central filament projects a short way out from the extremity. The remaining joints of this limb are smooth and almost devoid of spines. The other thoracic appendages (Pl. VIII. fig. 4) are all similar to each other, save that in the last pair, the third, fourth, and fifth joints are clothed with a closely set row of fine delicate hairs in addition to the sharp sword-like spines which are found here as in the other appendages; in the female these hairs appear to be absent. The same difference between the two sexes in this appendage has been already described in *Serolis convexa* (*ante*, p. 40), and it exists in other species. The terminal joints of the thoracic appendages from the third pair onwards are divided by a suture into a short distal and a long proximal half.

The *first three abdominal appendages*, like those of many other species, have the inner angle of the basal joint prolonged into a process which bears three branched hairs in the first and two such hairs in the two following pairs of appendages. The suture upon the *opercula* is inclined at an angle with the transverse axis.

The *uropoda* are attached exactly half way down the lateral margin of the caudal shield, but do not extend as far as its extremity.

Station 145, December 27, 1873; lat. 46° 43′ S., long. 38° 4′ 30″ E.; 140 fathoms; bottom, volcanic sand.

Station 149B, January 17, 1874; lat. 49° 28′ S., long. 70° 30′ E.; 25 fathoms; volcanic mud; off Marion Island, 50 fathoms.

Station 149C, January 19, 1874; lat. 49° 32′ S., long. 70° 0′ E.; 60 fathoms; bottom, volcanic mud.

Station 149D, January 20, 1874; lat. 49° 28′ S., long. 70° 13′ E.; 28 fathoms; bottom, volcanic mud.

6. *Serolis cornuta*, Studer (Pl. I. figs. 1–16).

Serolis cornuta, Studer, Beitr. zur Kennt., &c., Archiv f. Naturgesch., 1879, p. 19.

This species has been described by Studer in his Memoir on the Fauna of Kerguelen,[1] where a figure is given of the male and certain of the appendages. The males and

[1] *Loc. cit.*, pp. 21–24.

females differ from each other in their shape; as in *Serolis schythei*, the male is much broader in proportion to its length, being nearly circular in outline; in the female the shape of the body is oval; this difference depends upon the greater length of the epimera; in the male the sixth pair extend nearly so far as the end of the terminal spine of the caudal shield, while the two abdominal epimera extend about half way down the caudal shield, their posterior extremities being situated on a line with the articulation of the uropoda; in the female the sixth thoracic epimera only just pass beyond the articulation of the uropoda, while the abdominal epimera hardly reach as far.

The sterna of the abdominal segments differ in the two sexes; in the male the two first are oblong in shape, the posterior margin being slightly concave, the third is prolonged into a flat triangular spine; in the female the posterior margin of all the segments is prolonged into a blunt spine; the length of these increases progressively from before backwards.

Studer has given a good general description of this species, comparing it with *Serolis trilobitoides*, to which it is most nearly allied. For the sake of completeness I give here a recapitulation of his description, with a few additions, which applies to all the specimens in the Challenger collection, the variations being inconspicuous and confined to the colour, which is darker or lighter, and the number of spines upon the carina of the caudal shield, which vary from three to six.

The length of the largest male specimen is 34 mm., its breadth 31 mm.; the length of the largest female specimen is 41 mm., its breadth 35·5 mm.

The length of the *cephalic shield* is about one-fifth of the whole length of the body; close to the anterior margin is a transverse ridge which runs almost parallel to it; in front of the eyes, and occupying the middle of the cephalic shield, is a squarish area raised and separated off by a groove; the posterior margin of this is slightly concave, the two ends being somewhat produced backwards; the lateral portions of the cephalic shield in front of the eyes slope gradually downwards towards the side; behind and to the inside of the eyes is a large blunt conical tubule, one on either side; between the two, and forming the posterior boundary of the cephalic shield, is a flattened triangular area.

Thorax.—The epimera are broad and sickle-shaped, and the terminal portions from the articular process outwards project freely and do not overlap each other; the articular processes are short, and as in many other species, there are only two to each epimeron; the posterior articular process of each epimeron overlaps the anterior articular process of the succeeding epimeron.

The second, third, and fourth epimera are separated from their terga by a distinct suture. The anterior epimera are separated into two halves by a transverse ridge, and there is in addition an anterior ridge as in *Serolis bromleyana* and *Serolis gracilis*, which is a continuation of the anterior ridge on the cephalic shield; it runs at first parallel to the anterior margin of the epimeron at some little distance from it, and then bends

abruptly at right angles, terminating a little way in front of the second transverse ridge. The margins of all the epimera are minutely serrated externally. The terga of the free thoracic segments have almost the same antero-posterior diameter, the two last being only a trifle narrower; the sterna of the first two thoracic segments are as usual divided by sutures into a median and two lateral sclerites; the median sclerite of the anterior segment is keeled, that of the second has a short keel, widening behind and extending over its anterior half only. The posterior margin is raised into a ridge, which is continued along the lateral sclerites, but is here rather narrower. The sterna of the three last segments are partly fused as in other species.

Abdomen.—The caudal shield is rather more than one-third of the length of the whole body; its shape is pentagonal, and the end is produced into a long spine; there is a distinct longitudinal keel, which is furnished with three to six short recurved spines, the first of which is always the largest; at the anterior end of the caudal shield are two short spines, one on either side, and closely approximated to the middle line; from the outer margin of each of these runs a fold somewhat curved in its course, which terminates a little in front of the attachment of the uropoda in a short spine; this lateral fold is similar to that found in *Serolis paradoxa* and *Serolis schythei*, and perhaps marks the boundary of the last segment of the abdomen; the lateral margins from the attachment of the uropoda to the terminal spine are provided with a number of small teeth.

On Pl. I. are figures of a male (fig. 1), female (fig. 2), and an immature male specimen (fig. 3); the latter is introduced in order to show its similarity in shape to the female (see p. 27).

The first pair of *antennæ* are shorter than the second pair by about half their own length; the terminal joint of the base is large, being rather more than half as long as the preceding joint; the filament, which is about as long as the rest of the antenna, has twenty-five joints.

In the second pair of antennæ the basal portion has as usual five joints, of which the last is the longest, being about equal in length to both the third and fourth joints together. The filament is nearly but not quite as long as the fifth joint, and is composed of fifteen or sixteen joints. One of these is shown highly magnified in Pl. I. fig. 6; on the inner and lower surface of some of the joints towards the middle of the filament is a row of short lancet-shaped spines; these decrease in size towards the distal end of the filament, and in the last three or four joints seem to be entirely absent; they commence to be visible on about the third joint of the filament, but are only present in small numbers towards the distal end of the joint and close to its articulation with the one in front. The figure (Pl. I. fig. 6) represents the seventh joint; these spines, which are present upon the antennæ of both sexes, are like those that are found in *Serolis paradoxa*, and which have been described (*ante*, p. 35).

Mandibles.—The distal extremity of the right and left mandibles of a male specimen

of *Serolis cornuta* are shown on Pl. I. figs. 7 and 8. The right mandible (fig. 7) has upon the upper surface a broad chisel-like process which is absent from the left; the latter is compensated by two large bifid spines instead of the single spine which springs from the lower surface of the right mandible. In another specimen, however, these conditions were reversed, the chisel-like plate being developed only upon the left mandible, while the right mandible had two spines.

The *first pair of maxillæ* are quite like those of other species.

The *second* pair (Pl. I. fig. 9) in one specimen were asymmetrical like the mandible; the middle lobe of the left hand maxilla had four spines, while the right hand one (Pl. I. fig. 10) had only two; in another specimen, however, both right and left maxillæ had only two spines.

The *maxillipedes* (Pl. I. fig. 11) are very much covered with hairs; the stipes, which is separated from the lamina by a complete suture, is squarish in outline; the palp is broad and flat, the second joint distinctly cordate in outline.

The *second pair of ambulatory limbs* in the male is modified in the usual way; a single spine similar to those which are found upon the inner margin of the penultimate joint of these appendages is also found on the inner side and close to the distal end of each of the two preceding joints.

The remaining ambulatory limbs are in no way remarkable; they are more like those of *Serolis schythei* than any other species; the first joint is the longest and broadest; the second joint is narrower and slightly shorter; it increases in width towards the distal extremity, which is furnished with a tuft of comparatively delicate spines and hairs; the third and fifth joints are subequal in size, while the fourth is a trifle longer; large sword-like spines mingled with smaller ones, and a very few serrated spines, are arranged in tufts on the inner and outer sides of the distal extremity of these joints, and a few along the outer margin.

The *three anterior abdominal appendages* of the female are displayed in figs. 12–14 of Pl. I.; as in *Serolis septemcarinata* and others the basal joint of the first (fig. 12) has three branched hairs like those which clothe the outer margin of the exopodite and endopodite of the same appendages, but smaller; the second and third of these appendages (figs. 13, 14) have two hairs instead of three.

The suture upon the exopodite of the fourth pair of abdominal appendages is oblique.

The *uropoda* are attached about half way down the caudal shield, and extend as far as its termination, the exopodite does at least, being almost half again as long as the endopodite; the outer margins of both, and the distal extremity of the inner margin are serrated and beset with branched hairs.

Station 149, January 9, 1874; lat. 49° 8′ S., long. 70° 12′ W.; 25 fathoms; bottom, volcanic mud. January 13, Betsy Cove, Kerguelen Island.

Station 149B, January 17, 1874; lat. 49° 28′ S., long. 70° 30′ W.; 25 fathoms; bottom, volcanic mud.

Station 149D, January 20, 1874; lat. 49° 28′ S., long. 70° 13′ W.; 28 fathoms; bottom, volcanic mud.

Station 149E, January 21, 1874; lat. 49° 37′ S., long. 70° 16′ W.; 30 fathoms; bottom, volcanic mud.

Station 149K, January 29, 1874; lat. 48° 40′ S., long. 69° 6′ W.; 45 fathoms; bottom, volcanic mud.

7. *Serolis bromleyana*, Suhm (Pl. IV.).

Serolis bromleyana, v. Willemoes Suhm, Proc. Roy. Soc. Lond., vol. xxiv. p. 591, 1876.
Serolis bromleyana, Challenger Briefe, No. II., Zeitschr. f. wiss. Zool., Bd. xxiv. p. xix., 1874.

This species, which is considerably the largest of the genus, has been already briefly characterised by the late Dr. v. Willemoes Suhm from two specimens dredged in 1975 fathoms near the Antarctic Ice-Barrier. The following description is taken from these specimens:—Length of male 54 mm., greatest breadth (at the level of the third epimera) 56 mm.; length of female 45 mm., greatest breadth 39 mm.

The male differs from the female by its greater size and in the greater length of the epimera; in both sexes the length of the thoracic epimera gradually increases up to the sixth, which are by far the longest, and extend for a considerable distance behind the termination of the caudal shield. The extreme length of these epimera, measured from their articulation with the epimera of the preceding segment, is 47 mm. in the male and 33 mm. in the female. The epimera of the second and third abdominal segments project beyond the caudal shield in the male; in the female the last pair barely reach as far as its termination. The form of the sterna of the free abdominal segments does not differ at all in the two sexes.

The outline of the body is more or less oval, and the great length of the epimera, which become extremely narrow and spiniform towards their end, serves to distinguish this species from all others, with the exception of *Serolis neœra* and *Serolis gracilis*. From both these species, however, it can readily be separated by numerous other points of difference. The body is covered with scattered hairs, which are especially developed upon the sides of the epimera. The colour (in alcohol) is violet-grey with whitish yellow patches upon the caudal shield and posterior portion of the thorax; the colour of the living animal is described by v. Willemoes Suhm as being of "a fine blue colour with a red spot extending over the midst of the body and the eyes."

Cephalic Shield.—The shape of the cephalic shield can be understood by a reference to Pl. IV. fig. 1; it is longer than broad, owing to the projection of its lateral portions for some way in front of the rostrum; these antero-lateral portions of the cephalic shield

are separated from the rest by a ridge which runs from just below the rostrum to the lateral margin on either side; the whole cephalic shield is very distinctly separated from the thoracic segment by a deep furrow; the central portion which lies between the eyes is very strongly convex, and separable into three regions—two round convexities which lie to the inner side of and behind each eye, and a median T-shaped elevation, at the upper end of which, on a level with the anterior portion of the eyes, are four tubercles arranged in a semicircle with the concavity directed forwards; at the hinder extremity is another short tubercle; the whole surface of the cephalic shield, with the exception of a flattened area which extends from the upper end of the eyes to the transverse ridge, is covered with minute pit-like depressions. The eyes are whitish yellow in colour.

Thorax.—The thoracic segments, like the cephalic shield, are covered with an immense number of irregular pit-like depressions; the posterior margin of each segment is furnished with a minute tubercle. The epimera are of great length, and increase gradually from the first up to the sixth and last pair.

The epimera of the first thoracic segment are as usual large and expanded, but narrow rapidly towards the distal extremity, which is narrow and spine-like as in the succeeding segments. The anterior margin of these epimera bears a short forwardly directed spine at about 3 mm. distance from the cephalic shield. The epimeron is divided into three pieces by a Y-shaped ridge; the two arms of the Y form a very obtuse angle, one is continuous with the anterior spine already referred to, and the other passes outwards towards the distal end; the unpaired arm seems to correspond to the suture which is often developed upon the first pair of epimera in other species. The two areas lying respectively in front of and behind this median ridge are somewhat concave, while that portion which lies to the outside of the arms is convex.

The epimera of the three succeeding segments are curved and sickle-shaped, and project outwards at a greater angle with the longitudinal axis of the body than the rest, which by degrees come to lie almost in the same straight line with this axis. A distinct suture separates the dorsal portion of the three anterior free thoracic segments from these epimera. All the epimera of the body project downwards as well as outwards, especially in the male specimen, so that when the animal is placed upon a flat surface, the body rests entirely upon the epimera. The second of the free thoracic segments is the widest, and measures 4·5 mm. in diameter; the first and third are a trifle smaller, while the fourth and fifth are only one-third of the diameter of the second.

The sterna of the two first thoracic segments are divided by sutures into three portions, a median and two lateral. The median portion of the anterior segment (that which bears the maxillipedes) is keeled; the sterna of the second, third, and fourth segments are divided by a median suture into two equal halves; the remaining segments have a rather peculiar arrangement, which is displayed in Pl. IV. fig. 2; the middle portions of the three segments are fused together to form a somewhat oval plate, divided by a median

suture, and upon which two transverse furrows mark the boundary between the several segments of which it is composed. The lateral portions of the sterna of the three segments are at first fused together, but become separate just before the attachment of the appendages; and a triangular plate with the apex directed posteriorly, lies between the median and lateral portions of the sternum of the sixth segment.

Abdomen.—The first abdominal segment has as usual no epimera; its width is about double that of the preceding thoracic segment; the second and third abdominal segments are long and well developed, and terminate in a somewhat bifid extremity, the inner limb of the bifurcation being considerably longer than the outer (figs. 1, 2). The sterna of the three free abdominal segments are shown in fig. 2; there is a short median backwardly projecting tubercle, longer in the second and third than in the first; this is continuous with a longitudinal ridge which is crossed at right angles by another ridge. The male and female specimens, as already mentioned, show hardly any differences in the conformation of these abdominal sterna; in the female the antero-posterior diameter is somewhat less, and the median tubercle somewhat more pronounced than in the male.

The *caudal shield*, which is broader than long, has a somewhat pentagonal contour with rounded angles; the uropoda are attached about half way down the side, the posterior extremity is notched and rather turned up; there is a median longitudinal keel, and on either side a short flat spine near the lateral margin, and on a level with the attachment of the uropoda; the surface between the keel and these spines is almost flat, but is strongly bent downwards; the length of the caudal shield in the male is 17 mm., almost half that of the rest of the body, its breadth 21 mm.

Appendages.—The *antennæ* are almost exactly of the same length. The first pair of antennæ has four joints and a terminal filament made up of thirty-one joints, and equal in length to the first four joints.

The basal joint is oval, with a truncated distal extremity; the second joint slightly longer, with a straight outer and convex inner margin; the third joint is half again as long as the second and about half its width; it is cylindrical in shape; the terminal joint is about one-third of the length of the preceding joint, and of the same shape.

The second pair of antennæ have six joints and a short terminal filament; the sixth joint is the longest, the third is slightly longer than the fourth; the two basal joints are small, especially the second, which only occupies one side of the antennæ, on the other (inner) side the first joint articulates directly with the third; on the fourth, fifth, and sixth joints are a series of ridges running transversely to their long axes, and bearing bunches of fine hairs.

The *mandibles* are as usual asymmetrical; the left hand one has a projecting chisel-shaped process which is wanting in the right hand one.

The *maxillæ* are like those of other species; the anterior pair has nine or ten curved spines upon the cutting edge, the most anterior of which appear to be the largest.

In the *maxillipedes* (fig. 8) the stipes and lamina are not separated by a complete suture.

The second pair of thoracic appendages in the male are modified like those of all other species; the inner side of the second, third, and fourth joints is clothed with fine delicate hairs (Pl. IV. fig. 6) similar to those of *Serolis neœra*, but more delicate and inconspicuous; these structures I was only able to find in some of the specimens from Stations 168 and 169; in the large specimen from Station 156 (*cf.* Pl. IV. fig. 5) they are certainly not present, nor in the single specimen from Station 164A. It does not appear quite certain whether the presence or absence of these hairs is merely a local variation or an indication of a dimorphism in the males of this species analogous to that which Fritz Müller[1] has described in a species of *Tanais*.

The remaining thoracic appendages are slender, like those of *Serolis gracilis*, and, as in that species and others, the fourth joint is longer than the third or fifth joints; the hairs and spines are also small and delicate; neither the serrated spines found in many species nor the pinnate hairs found in *Serolis neœra* and *Serolis gracilis* seem to occur in this species; at the distal end of the penultimate joint only are there very long slender hairs, many of which are considerably longer than the terminal joint of the appendage.

The *abdominal appendages* are like those of *Serolis antarctica*.

The operculum is divided by a transverse suture at right angles to its longitudinal axis.

The *uropoda* are comparatively small, and attached at the commencement of the posterior third of the caudal shield.

Variations.—The description just given refers to two specimens dredged at Station 156; this species was also obtained at three other Stations, viz., Stations 164C (400 fathoms), 168 (1100 fathoms), and 169 (700 fathoms), and some of the specimens show certain differences, chiefly in the length of the posterior thoracic epimera and in the conformation of the two abdominal epimera; in one specimen (Pl. IV. fig. 3) the posterior thoracic epimera, instead of lying nearly parallel to the long axis of the body, are curved inwards towards the extremity so as to partly enclose the caudal shield; in this specimen the last thoracic epimera are proportionately longer than in the type specimen, measuring 36 mm. as against 35 mm. length of body, whereas in the type specimen these epimera, as already stated, measure 47 mm., the length of the body being 54 mm. In the majority of specimens the abdominal epimera terminate in a sharp point and are not notched at their extremity; two other specimens, however, had abdominal epimera precisely like those figured on Pl. IV. fig. 1, and since both these specimens are small, not measuring more than half the length of certain other specimens in which the abdominal epimera terminate simply in a point, this character cannot be looked upon as peculiar to adults.

In all the specimens obtained at Stations 168 and 169, the ridges upon the cephalic

[1] Für Darwin (Facts for Darwin), English translation, London, 1869, p. 19 *et seq.*

shield are somewhat different from those figured and described in the type specimens; a strong ridge runs parallel to the outer margin of the epimera; at its upper extremity it bends backwards and passes for a short distance parallel to the boundary line of the cephalic shield, terminating a little below the ridge which crosses the latter; the transverse ridge, which indicates the division of the epimeron into two parts corresponding to the first two thoracic segments, is very slight; the anterior spine-like process of these epimera is not present, and the anterior margin is in consequence quite smooth (fig. 3). Many of these specimens are more darkly coloured.

In a small specimen from Station 164c (400 fathoms), measuring 16 mm. in length, the outer ridge upon the anterior epimera is not present, but the abdominal epimera have the same characters as those of the type specimens.

Station 156, February 26, 1874; lat. 62° 26′ S., long. 95° 44′ E.; 1975 fathoms; bottom, Diatom ooze.

Station 164c, June 13, 1874; lat. 34° 19′ S., long. 151° 31′ E.; 400 fathoms; bottom, green mud.

Station 168, July 8, 1874; lat. 40° 28′ S., long. 177° 43′ E.; 1100 fathoms; bottom, blue mud.

Station 169, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; 700 fathoms; bottom, blue mud.

8. *Serolis neœra*, F. E. B. (Pl. V. figs. 1–11).

Serolis neœra, F. E. Beddard, Proc. Zool. Soc. Lond., 1884, pt. iii. p. 331.

This species almost rivals *Serolis bromleyana* in size, and resembles it in the great length of its spiniform epimera.

The largest male measures 42 mm. in length and 48 mm. in breadth; the largest female measures 41 mm. in length and about 40 mm. in breadth. The difference in the proportion of length to breadth in the two sexes is caused by the greater development of the epimera in the male; the two sexes also differ in the characters of the sterna of the abdominal segments and in the frontal "sense organ," which is much larger and more evident in the female (*cf.* figs. 1 and 3); there is not such a marked difference between the lengths of the abdominal epimera in the two sexes as is often found in the other species of *Serolis*.

Cephalic Shield.—The eyes are unusually large and conspicuous, 6 mm. long, bluish black in colour owing to the comparatively small amount of pigment present; the diameter of the cephalic shield is greater than its length; as in *Serolis bromleyana*, a transverse ridge passes from the base of the rostrum to the lateral margins of the cephalic shield, and cuts off a small antero-lateral portion; the anterior margin of this as well as of the first epimera is bent upwards. Between the eyes are a number of spiniform pro-

cesses which are hollow and filled up with connective tissue, two smaller median spines and two outer ones with a bifid extremity; the posterior margin of the cephalic shield is indented, and forms three projections, the two outer ones being somewhat triangular in shape, and tuberculated on the free margin, while the inner median one is transversely elongated, and much like the labium in shape, with a slightly convex outer margin.

Thorax.—Each of the thoracic segments is furnished with a median spine—the first three are considerably longer than the rest; the antero-posterior diameter of the thoracic segments increases from the first to the fourth, the latter measuring 3·5 mm. in the male; the two last thoracic segments are comparatively longer than in *Serolis bromleyana*, rather more than half as long as the preceding segment. The terga of the three anterior free thoracic segments are separated from their epimera by a distinct suture. The epimera of the segments gradually increase in length up to the sixth pair, which are extremely long, measuring 37 mm. in the male, and extend backwards in a direction nearly parallel to the long axis of the body.

The first epimera are larger in the male than in the female (*cf.* figs. 1, 3); in the latter the margin of the epimera passes at first abruptly backwards, and then curves outwards; the antero-lateral portion of the cephalic shield projects outwards beyond the commencement of the epimeron for a short space, and ends in a truncated slightly notched extremity; in the male the outer margin of the first pair of epimera is quite regular. The epimera are divided into two halves by a longitudinal ridge.

The sterna of the two anterior segments are as usual divided by sutures into three sclerites; the anterior segment is similar in shape to that of *Serolis bromleyana;* the median sclerite of the second segment is saddle-shaped as in the last mentioned species, but instead of being smooth the anterior half is produced downwards into a triangular process; the posterior half is raised into two knobs, which are separated from each other in the median ventral line by a suture. The three succeeding segments are divided by a median suture which is continuous to the end of the thoracic segments. The sixth, seventh, and eighth thoracic segments are entirely similar to those of *Serolis bromleyana* above described.

Abdomen.—The epimera of the second abdominal segment extend for a space of about equal to half its own length beyond the caudal shield; they are not perceptibly longer in the male. The epimera of the third segment are very short, and only extend to about the commencement of the lateral margin of the caudal shield; the length of these epimera also does not differ in the two sexes. The posterior extremity of the first pair of these epimera is notched as in *Serolis bromleyana.* The sterna of the three free abdominal segments differ in the two sexes; in the female the posterior margin of each is produced into a short spine, the first being the largest and longest; in the male the last of the three segments only has a spine.

The *caudal shield* is almost hexagonal in outline; its length in both the male and female is about 11 mm.; it is therefore smaller in proportion than that in *Serolis bromleyana;* its breadth is about 12 mm. The uropoda are attached at about the commencement of the posterior fourth. The median portion of the shield is slightly keeled, and bears two spines one in front of the other, the posterior being the larger of the two. On either side are two other short flat spines. The caudal shield of this species is very similar to that of *Serolis schythèi*, but it is not so distinctly carinate, and the anterior median spine is flatter and not so large as in *Serolis schythei*, while the posterior median and the lateral spines are larger than in that species.

Appendages.—The second pair of antennæ are a little longer than the first pair.

In the *first antennæ* the two basal joints are of about equal length, the third joint is twice as long as either of the preceding ones, the fourth joint short, hardly longer than the first joint of the filament; the filament is composed of about twenty joints.

The *second pair of antennæ* have the third, fourth, and fifth joints as usual covered on the inferior surface with tufts of hairs in groups of three or four; the filament has some fifteen joints.

The *mandibles* do not appear to differ from those of other species.

The *first maxillæ* consist as usual of a stout elongated lobe and small oval lobe, both of which articulate with the cardo; the smaller lobe is furnished on the free cutting edge with a single spine as it is in *Serolis paradoxa* (*cf.* Pl. V. fig. 14).

The *maxillipedes* are figured on Pl. V. fig. 6; the suture between the lamina and stipes is complete; the palp of the mandible is abundantly furnished with setæ, and the second joint has on the inner side the small protuberance characteristic of all the deep-sea species of the genus (*a*).

The *second pair of thoracic appendages* differ from those of other species in that the hairs which clothe the inner margin of the penultimate joint are very similar in form; several of these are shown on Pl. V. fig. 7; the longer hairs (*a*) only differ from the shorter ones (*b*) by the proportions of their length and breadth.

The *third pair* (fig. 8) are as usual modified into a prehensile organ in the male; the third, fourth, and fifth joints are covered on the inner side with a dense row of hairs which are shown magnified in fig. 9, a′; these hairs are clothed on the distal half with fine branches, and they closely resemble the hairs that are found on the second thoracic appendage of the males of *Serolis convexa.* The fifth joint is oval, narrowing towards the upper extremity; it possesses the peculiar spines characteristic of this appendage; they are narrow and cylindrical, and terminate in a long thread which is given off from the upper surface of the spine just before its termination (fig. 9, b′). The sixth joint is divided by a suture into a small distal portion and a long proximal portion.

The *ambulatory limbs* differ from those of other species in the character of the hairs; instead of sharp serrated spines, which are generally developed upon these appendages, the ambulatory limbs of *Serolis neœra* are clothed with long branched hairs similar to those found upon the three anterior abdominal appendages, but somewhat shorter. One of the limbs of the right side is figured on Pl. V. fig. 10; the other thoracic limbs hardly differ at all, except that the last is considerably shorter as in other species. On the inner margin of the proximal joint are a number of very fine hairs, the distal half being furnished with delicate branches. These hairs are exactly similar to the terminal hair of the first antennæ in this and other species, and are possibly sensory. The remaining joints are provided with bunches of branched hairs, those on the inner side of the limb being longer than those on the outer side; the arrangement of these can be seen by an inspection of the figure (fig. 10); the terminal joint forms as usual a claw which is long and slender.

Abdominal Appendages.—These appendages present no peculiarities; the basal joint of the first pair is furnished with three hairs upon the inner posterior angle. The two following appendages have each two hairs in the same place.

The exopodite of the first pair of gills is divided by an oblique suture, and the endopodite is bifid at the tip (see fig. 11).

Another specimen of this species which was dredged in 2040 fathoms (Station 318) is in some respects different, but the differences do not appear to me to be of sufficient importance to warrant its separation as a distinct species.

The epimera, instead of being long and spiniform as in all the other specimens contained in the Challenger collection, are comparatively short, and resemble the epimera of the typical shallow-water forms (*e.g.*, *Serolis schythei*) in being comparatively wide and flattened; the two posterior thoracic epimera were unfortunately broken off on both sides of the body, but judging from what remains it seems very likely that the sixth pair at any rate extend back beyond the termination of the caudal shield. The anterior pair of abdominal epimera terminate a little way in front of the attachment of the uropoda.[1]

Station 318, February 11, 1876; lat. 42° 32′ S., long. 56° 29′ W.; 2040 fathoms; bottom, blue mud.

Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; 600 fathoms; bottom, green sand.

[1] This specimen was mounted on a slide in glycerin; on the same slide, entangled with the appendages of the *Serolis*, were several small Nematodes, not sufficiently well preserved to exhibit any distinctive generic character. It is of course not certain that they came from the same depth as the Crustacean, but, bearing in mind the fact that many of the marine free-swimming Nematoidea attach themselves in a semiparasitic fashion to other animals (*cf.* Villot, Arch. d. Zool. Exp., t. iv. p. 451, 1875), it is at any rate possible; so little is known respecting the distribution of the free-swimming Nematoidea that I think it worth while to record this fact, especially as I observed other Nematoidea among the appendages of one of the specimens of this same species from Station 320.

9. *Serolis gracilis*, F. E. B. (Pl. III. figs. 7–13).

Serolis gracilis, F. E. Beddard, Proc. Zool. Soc. Lond., 1884, pt. iii. p. 332.

Five specimens of this species were dredged at Station 120 (675 fathoms), three males and two females.

The males were approximately of the same size, the largest measuring 21 mm. in length by 22 mm. in breadth; the females were much smaller, measuring 9 mm. in length, by 8 mm. in breadth.

The chief difference between the two sexes, apart from that of size and relative proportions of length and breadth, consists in the greater length of the epimera in the males; in the female specimens (Pl. III. fig. 8) the last thoracic epimera hardly reach as far as the end of the caudal shield, while the first abdominal epimera only extend about half way down, and the posterior abdominal epimera terminate at about the level of the end of the anterior third of the caudal shield; in the male (Pl. III. fig. 7) the posterior thoracic epimera are considerably longer, reaching beyond the caudal shield for a space of about its own length; the actual length of these epimera is 13 mm.; the first abdominal epimera extend a short way beyond the end of the caudal shield, and the posterior pair to about the middle. The difference between the two sexes in the length of the epimera is more marked in this species than in any other known to me.

The general form of the body is circular, and the dorsal surface is covered with scattered pits; the colour (in alcohol) is a dark slate-blue, varying to reddish yellow upon the terga of the posterior thoracic and abdominal segments.

The *cephalic shield* has much the same shape as in *Serolis bromleyana;* the portion lying between the eyes, which are small and inconspicuous, is strongly convex, while the antero-lateral areas are flat and depressed, and do not rise above the level of the first thoracic epimera; a transverse ridge running from the base of the rostrum, which is very minute, divides the cephalic shield as in *Serolis bromleyana.*

Thorax.—The first epimera are divided into three portions by two transverse ridges; the anterior one is continuous with the ridge that traverses the cephalic shield, it passes at first across the epimeron and then bends backwards running parallel with the anterior margin of the epimeron, and joins the distal end of the second ridge; the continuation of these two ridges passes along the margin of the epimeron closely applied to it, and terminates some way in front of the end of the epimeron. The posterior ridge corresponds to the line of suture between the two fused epimera of the first and second thoracic segments.

The other epimera are flat and sickle-shaped, not spiniform as in *Serolis bromleyana* and *Serolis neœra;* they gradually increase in length up to the sixth; the articular processes, which unite together the succeeding epimera, are placed further than is usual from the junction between the terga and the epimera, which gives the latter the appear-

ance of being shorter than they really are; the fourth and fifth as well as the three anterior epimera are separated from the terga by a distinct suture. The antero-posterior diameter of the three anterior free thoracic segments gradually increases from the first to the third; the diameter of the fourth and fifth is rather more than half that of the third. The sterna of the two first thoracic segments are as usual divided by lines of suture into three portions; the median sclerite of the first segment is keeled, and that of the second segment has a median keel which bifurcates posteriorly; the hinder half of this sclerite is divided by a median suture continuous with that which separates the right and left halves of the sterna of the succeeding segments. As in *Serolis bromleyana* and *Serolis neœra*, the median portions of the sterna of the last three thoracic appendages are fused, though the lines of division corresponding to the three segments are more strongly marked in this species than in the two above mentioned.

Abdomen.—The epimera of the abdominal segments have been already described (*ante*, p. 13); the sterna do not appear to differ in the two sexes. The *caudal shield* is squarish in outline, 7 mm. in length by 8 mm. in breadth; its length is therefore not quite one-third of that of the whole body. The uropoda are attached close to its posterior margin. There is a slight longitudinal median keel, which is crossed at right angles by a sinuous ridge with three convexities, one median and two lateral, which correspond to the spines on the caudal shield of *Serolis neœra* and *Serolis schythei;* at about the end of the anterior third of the caudal shield is a short flat spine in the middle line and two oblique ridges, one on either side of this spine; the lateral portions of the caudal shield are bent down.

The two pairs of *antennæ* are of about equal length. In the anterior pair the first joint is short and oval; the second joint is a little longer, and the upper margin projects a little way beyond the articulation of the succeeding joint, which is nearly twice its length, narrow, and bent downwards. The filament has fourteen joints.

The two distal joints of the basal portion in the second antennæ are furnished with hairs arranged in tufts along the upper margin. The filament has twelve joints.

In the *maxillipedes* (Pl. III. fig. 10) the stipes and lamina are not separated by a complete suture; the second joint of the palp has a small tubercle near the base covered with hairs as in the other deep-sea species.

The *third thoracic appendages* in the male resemble those of *Serolis neœra* in that the inner margin of the third and fourth joints bears a number of delicate plumose hairs; a few are also to be found at the upper extremity of the second joint; the penultimate joint is swollen and considerably broader at the base; the inner margin has about a dozen pairs of conical papilla-like spines which grow longer and narrower towards the distal extremity, where they come to resemble exactly the plumose hairs upon the anterior joints.

The *ambulatory limbs* are rather slender, and the joints elongated; the fourth is always longer than either the preceding or succeeding joint; the spines upon these appendages are not very much developed; the second and third joints in all bear a few pinnate hairs upon the inner margin close to the articulation with the succeeding joint; the remainder of the limb is furnished with delicate sword-like spines arranged in tufts upon the inner side; mixed with these are a few strong serrated spines which are most abundant upon the distal extremity of the penultimate joint. The inner side of the third, fourth, and fifth joints in the last ambulatory limb (Pl. III. fig. 11) is covered with soft pinnate hairs (fig. 12), like those found on the second pair of thoracic appendages of the male, and the inner side of the first ambulatory limb is similarly provided with these hairs, though to a less extent.

The *three anterior abdominal appendages* are like those of other species; the basal joint is prolonged outwards, and bears two to three branched hairs at the tip.

The suture which divides the exopodite of the opercula is oblique; the exopodite of the gill appendage is bifurcate.

Station 120, September 9, 1873; lat. 8° 37′ S., long. 34° 28′ W.; 675 fathoms; bottom, red mud.

10. *Serolis antarctica*, F. E. B. (Pl. III. figs. 1–6).

Serolis antarctica, F. E. Beddard, Proc. Zool. Soc. Lond., 1884, pt. iii. p. 333.

The three species above described agree with each other and differ from all other known species of the genus in the great development of the epimera. *Serolis antarctica*, the only other deep-sea form, has comparatively short, flat epimera as in the shallow-water species of *Serolis*. This species may be distinguished by the entire absence of eyes, and by the strongly marked sculpturing upon the dorsal surface of the body.

The Challenger collection contains eight specimens besides some fragments. The four male specimens are all approximately of the same length, the largest measuring 33 mm. in length by 31 mm. in greatest breadth. The remaining specimens, which are females, vary in size; the largest measures 31 mm. in length by 26 mm. in greatest breadth. The males, therefore, appear to be larger than the females, and also broader in proportion to their length; the contour of the body in the males is oval, in the females somewhat pear-shaped (*cf.* Pl. III. figs. 1, 3); the epimera are proportionately longer in the males, those of the sixth pair project a little way beyond the end of the caudal shield; the abdominal epimera are much the same length in the two sexes, and reach about half-way down the caudal shield; in the female the sixth thoracic epimera do not project beyond the caudal shield; the second pair of abdominal epimera are a trifle longer than the anterior pair, and both are very slightly shorter than the abdominal epimera in the male. The sterna of the abdominal segments do not seem to differ in the two sexes. The colour of this species (in alcohol) is violet-blue, inclining to reddish yellow in the middle of the body. The body has a nacreous glitter when seen by oblique light.

Cephalic Shield.—The cephalic shield is very slightly raised above the general surface of the body; its posterior surface is furnished with a short blunt tubercle; a slight ridge separates the antero-lateral portions from the rest, as in other species. The eyes are entirely absent, their place being occupied by a small tubercle similar to the rest of the chitinous integument, and containing no traces of any optic structures.

Thorax.—The dorsal surface of the thorax, as well as the rest of the body, is very much sculptured, more so than in any other species of the genus; upon the epimera the sculpturing takes the form of a network of ridges enclosing irregularly shaped roundish pits; the anterior half of the cephalic shield is sculptured in a similar fashion; the posterior part of the cephalic shield and the terga of the thoracic segments (especially upon their posterior portions) are covered with thicker ridges anastomosing irregularly; these are most conspicuous upon the lateral portions of the terga of the three anterior free thoracic segments. The sculpturing upon the terga of the abdominal segments is very slight. The sculpturing upon the caudal shield differed in different specimens; in some it resembled that of the epimera, in others the central portion between the median and lateral carinæ was occupied by a number of roundish irregularly scattered tubercles.

The posterior margin of all the thoracic as well as the abdominal segments is prolonged in the median line into a short blunt tubercle; these are larger upon the two last thoracic and the abdominal segments.

The first epimera are not divided into two portions by a suture; the succeeding epimera are closely applied to each other, the extreme end alone projecting freely; they are rather different in shape from what is customarily found in *Serolis;* instead of rapidly narrowing towards the free extremity and terminating in a fine point, the anterior margin runs parallel to the posterior margin of the previous epimeron until just before the termination of the latter, when it passes abruptly backwards in a direction nearly parallel to the long axis of the body, and joins the posterior margin almost at right angles. The fifth and sixth epimera are more like those of other species.

The epimera of the three anterior free thoracic segments are separated from the terga by a suture.

The sterna of the first two thoracic segments have the usual form (Pl. III. fig. 4); the median sclerite of the first segment is keeled, that of the second segment has a short keel extending from the anterior extremity to about the end of the first third. The sterna of the three posterior thoracic segments are similar to those of the last described species (*cf.* Pl. III. fig. 2); the male genital pores are very closely approximated in the middle line.

One of the male specimens presents an abnormality in the presence of a pair of ovigerous lamellæ upon the third free thoracic segment; the lamella of the right side was about twice as large as that upon the left side.

Abdomen.—The three anterior abdominal segments have been already described; the

caudal shield measures 12 mm. in length by 12 mm. in greatest breadth in the male specimen, and 11 mm. in length by 11 mm. in breadth in the female; it is therefore more than one-third of the length of the animal; its shape is more or less hexagonal; the lateral portions are strongly bent down, and the uropoda come to be attached quite on the under surface, and are almost invisible from above; there is a median longitudinal keel which bifurcates at about the end of the anterior fifth, on either side is a Y-shaped keel inclined at an oblique angle; the portion of the caudal shield which lies between the median and lateral keels is flat, the part which lies outside the inner fork of the lateral keel is bent downwards; the posterior end of the caudal shield is slightly bent up.

Antennæ.—In the anterior pair the two first joints are short and about equal in size; the third joint is narrow and long, twice the length of either of the preceding joints; the fourth joint is very short; the filament has about twenty-eight joints, each of which has two sensory hairs; the filament is nearly as long as the basal portion of the antenna.

The second pair of antennæ are longer; the filament has about twenty-one joints, and is almost exactly equal in length to the last joint of the basal half of each of the antennæ.

The *mandibles* are like those of other species in being asymmetrical; the left bears on the upper surface a chisel-like process and above a single spine; the right has two spines.

The upper lobe of the *first pair of maxillæ* has ten spines upon its masticatory edge; the lower lobe has the usual form, and has but one slender spine close to the hinder margin of the cutting edge.

In the *maxillipedes*, the stipes and lamina are completely separated by suture; the margins of both are smooth; the second joint of the palp is comparatively slender; its inner edge is beset with hairs along the distal half; close to the middle of the joint is an oval prominence as in the other deep-sea species.

One of the *second pair of ambulatory limbs* in the male is shown on Pl. III. fig. 5. The distal joint is as usual bent back upon the one in front like the blade of a closed penknife upon its handle; the penultimate joint is considerably broader at the base, and bears about fourteen somewhat slender spines, arranged in pairs.

The remaining ambulatory appendages (Pl. III. fig. 6) are slender, and but scantily furnished with slender spines, some of which are serrated; these are only to be found at the distal extremity of the third, fourth, and fifth joints, and extending for a short way along the outer margin of the fourth and fifth joints.

The *three anterior pairs of abdominal appendages* have a tuft of two or three hairs upon the projecting outer angle of the basal joint.

The suture upon the operculum is at right angles.

The *uropoda* are extremely small, and attached near the end of the lateral margins of the caudal shield.

Station 122c, September 10, 1873; lat. 9° 10′ S., long. 34° 49′ W.; 400 fathoms; bottom, red mud.

Station 146, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; 1375 fathoms; bottom, Globigerina ooze.

Station 147, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; 1600 fathoms; bottom, Diatom ooze.

The above cited Monograph of Grube contains a description and figures of a species of *Serolis* (*Serolis tuberculata*) which differs from all the species known at that time and from all those already described in the present Report by the characters of the fifth and sixth thoracic segments; the tergum of the fifth segment, which is generally narrower than the preceding ones, is in this species extremely narrow, not measuring more than one-sixth of the diameter of the segment in front, while the tergum of the sixth thoracic segment has entirely disappeared: the Challenger obtained two specimens of this same species, *Serolis tuberculata*, besides examples of four other species which agree with *Serolis tuberculata* in the characters just mentioned; all these species are inhabitants of the shallow waters off the southern and eastern coasts of Australia, and form a well-marked group, agreeing with each other in a number of structural points. These species I have briefly described in my "Preliminary Report," and named as follows:—*Serolis pallida*, *Serolis australiensis*, *Serolis elongata*, *Serolis minuta*, and *Serolis longicaudata*; all these species, with the exception of *Serolis minuta*, agree with each other and with *Serolis tuberculata* in the following points, some of which are peculiar to the group, while others again are not confined to the group, but are also to be found in other species.

They are all of small size; the females are larger than the males (?). The thoracic epimera are short and closely applied together for their whole length, while the epimera of the two abdominal segments are very short and not prolonged beyond the anterior margin of the caudal shield. The tergum of the fifth thoracic segment is extremely narrow; the tergum of the sixth segment is obsolete in the middle line, the suture which separates it from the succeeding first segment of the abdomen passes forwards and disappears underneath the segment in front (*cf.* Pl. VI. fig. 1) in *Serolis tuberculata* and *Serolis pallida*; in *Serolis australiensis*, *Serolis elongata*, and *Serolis longicaudata* the general appearance of the two last thoracic terga is the same, but a careful inspection shows that the posterior sutures of both segments become obsolete just before the middle line of the body, so that which apparently is the tergum of the first abdominal segment in reality includes also the middle part of the terga of the two last thoracic segments. In *Serolis minuta* the fifth and sixth thoracic segments are not quite so narrow as in the other Australian species. The fifth segment is divided off by a sutural line which is entirely continuous from one side of the body to the other; the sixth segment, however, though proportionately somewhat broader, resembles that of *Serolis australiensis*, &c., in being fused mesially with the succeeding abdominal segment. In the other Australian species the rostrum is long, reaching beyond the first joint of the anterior pair of

antennæ. The sterna of the abdominal segments are prolonged into stout spines in both sexes. The caudal shield is truncated at its extremity. The proximal joint of the anterior abdominal appendages is narrow, and, as in *Serolis schythei*, the basal triangular process furnished with branched hairs is absent; the suture on the operculum is at right angles to the long axis of the body. The palp of the maxillipede has this peculiarity, that the second joint, instead of being cordate in shape, has the two margins curved inwards and parallel with each other.

This assemblage of characters is very distinctive of all the Australian species with the sole exception of *Serolis minuta;* this latter appears to be intermediate between the other Australian species and the more typical species of *Serolis* such as *Serolis paradoxa;* in the characters of the last thoracic segments, as above stated, it more closely resembles the former, while in other respects it comes nearer to the latter; it would be difficult to classify it definitely with either; for this reason, and also considering the compactness in other respects of the genus, it appears to me inadvisable to divide *Serolis* into two separate genera or subgenera.

11. *Serolis tuberculata*, Grube (Pl. VI. figs. 1, 2).

Serolis tuberculata, Grube, Archiv f. Naturgesch., 1875, p. 227.

The Challenger obtained two specimens of a small species of *Serolis*, which I identify with Grube's *Serolis tuberculata;* one of these specimens is a male, the other a female; they were obtained from different localities, the male from Station 161, the female from Station 162; the former specimen is unfortunately much damaged.

The female is larger than the male—it measures 19 mm. long by 17 mm. broad; the length of the male is 12 mm., its breadth about the same. It appears therefore that the males of this species, if not smaller than the females, are broader in proportion to their length, as is generally the case in this genus. The colour of the two specimens is rather different; the female is pale yellowish brown, with innumerable black dots; on the outside of each epimeron is a larger black spot; the male is of a uniform but darker brown.

I have but little to add to Grube's excellent description of this species; in my specimens the epimera are not so closely applied together as he describes, and this is especially the case in the male, where the points of all the epimera project freely. On the cephalic shield between and in front of the eyes is a semicircular ridge of the integument; the convexity is directed forwards, and the two lateral ends are prolonged backwards into two short spines; the lateral tubercles on the thoracic segments are eight or nine in number on either side, and are situated on a low ridge which commences near the junction of the tergal portion of the segment with its epimeral portion, and terminate a little before the middle of the segment; this ridge is longer in the third free thoracic

segment than in the rest. The two last thoracic segments have only one tubercle on either side, which form the outer extremity of a slight ridge.

Antennæ.—The first pair of antennæ has a stem composed of four joints, of which the third is rather more than twice as long as either of the two basal joints; the filament consists of some fifty joints; in the second pair of antennæ (Pl. VI. fig. 2) the third joint has its posterior border prolonged into a spine as figured by Grube;[1] the upper surface of this and the succeeding joint has a strong longitudinally running ridge; the upper margin of the fourth and fifth joints, which are as usual the longest, is sinuous, and a tuft of hairs springs from the summit of each of the elevations; the filament has about twenty joints.

In the *maxillipedes* the stipes is almost triangular in shape; the lamina is proportionately very stout and strong, its diameter being equal to that of the stipes. Just below the articulation of the palp is a curved ridge; the second joint of the palp, instead of being heart-shaped, has its two sides almost parallel, the curvature of the outer margin following that of the convex inner margin.

The third pair of thoracic appendages is quite, as described by Grube, but I am inclined to think that both his specimen and mine are immature males (*ante*, p. 16).

The ambulatory limbs of this species are characterised by being mainly provided with one kind of spines which are of varying length, but always stout and strong. The end is bent and seems to be of a somewhat softer consistency than the rest. The stout serrated spines, so characteristic of the ambulatory limbs of other species of *Serolis*, are only present in small numbers in *Serolis tuberculata*.

The *three abdominal appendages* are hardly different from those of other species; the basal portion is, however, not prolonged into an angle bearing two or three plumose hairs as in many other species; in this respect they agree with *Serolis australiensis*, &c. The exopodite of the first pair of gills is divided into two by a transverse suture, which is at right angles to the long axis.

Generally speaking, the appendages of *Serolis tuberculata* are very closely similar to those of the next species to be described.

A figure of the female is given on Pl. VI. fig. 1.

Station 161, April 1, 1874; off East Moncœur Island, Bass Strait; depth, 38 fathoms; bottom, sand.

Station 162, April 2, 1874; off East Moncœur Island, Bass Strait; depth, 38 to 40 fathoms; bottom, sand.

[1] *Loc. cit.*, pl. v. fig. 2.

12. *Serolis australiensis*, F. E. B. (Pl. VI. figs. 3–8).

Serolis australiensis, F. E. Beddard, Proc. Zool. Soc. Lond., 1884, pt. iii. p. 334.

Of this species three examples were obtained by the Challenger off the coast of South Australia, and I have been able to compare them with a specimen in the British Museum brought from the same locality.

The largest specimen is a female (Pl. VI. fig. 4) and measures 14 mm. in length by 11 mm. in greatest breadth; the two remaining specimens are both males (Pl. VI. figs. 3, 7), and are approximately of the same size, measuring 10·5 mm. in length and 9 mm. in breadth.

Apart from the form of the third thoracic and second abdominal appendages, I could detect no marked differences between the two sexes, unless it be that the females are really larger than the males in this and in the other Australian species.

The general form of the body of *Serolis australiensis* is oval, the male a little broader proportionately; the distinguishing feature of this species is the immense number of tubercles which cover the body, and are especially large upon the caudal shield and the posterior margin of the segments.

The *cephalic shield* is broadest at the level of the eyes, where it bulges out considerably on either side. Anteriorly and posteriorly it is narrower; the anterior margin is prolonged into a very long rostrum; there is a transverse ridge which forms the anterior margin of the caudal shield for a short distance on either side of the rostrum, and then bifurcates, the outer branch continuing along the anterior margin of the cephalic shield and giving off a short spine directed forwards at the level of the end of the first joint of the anterior antennæ; the inner branch follows the margin of the cephalic shield, but at some little distance from it, and the two unite at the lateral anterior angle, enclosing between them a somewhat boat-shaped depression. The tubercles on the cephalic shield are arranged in transverse rows; there is a larger spine just to the inside of the posterior third of the eye on either side directed backwards and slightly outwards, and a median spine about the same size situated near the posterior margin of the cephalic shield.

Thorax.—The epimera of the first segment are not divided by a suture. The three following epimera are closely applied to each other along their whole length; there is a slight break between the four anterior and the two posterior epimera; the two latter are closely applied to each other, but the outer margin of the fifth begins to curve backwards a little before the outer termination of the fourth epimeron, so that the angle of the latter projects freely. All the thoracic epimera, with the exception of the first, are separated by a suture from the tergal portion of the segments.

The terga of the thoracic segments, as well as the epimera, are covered with minute tubercles, which are distributed in longitudinal rows running from one side of the segment to the other; one row, which is constant in all the segments, and is rather more conspi-

cuous than the rest, forms the posterior boundary of the segment, and is continued along the posterior margin of the epimera. In front of this is another row of tubercles, which in the middle of the segment lies half way between the anterior and posterior margins; on either side it divides into two rows, each of which run close to the anterior and posterior margins of the segment respectively; in the two last thoracic segments this anterior row of tubercles is not present. All the segments of the body, with the exception of the fifth and sixth, the former of which, as in the other Australian species, disappears altogether in the middle line, are furnished with a larger tubercle exactly in the median dorsal line; these increase in size from before backwards; on the fifth segment (in the female specimen at least) the median tubercle is wide, and flattened and quadrifid at its extremity.

Abdomen.—The epimera of the second and third abdominal segments extend for a very short space beyond the lateral margins of the caudal shield; beneath, the three anterior segments are prolonged into a stout spine of unusual length (*cf.* fig. 3); the spine of the first segment, which is the longest, completely covers the spine of the succeeding segment; the spines in the female appear to be a little stouter than in the male, for in the male the spines are all rather slender; the differences, however, are insignificant and not well marked.

The *caudal shield* is more or less triangular in outline, distinctly carinate and truncated at its free extremity; its upper surface is covered with tubercles, which have no definite arrangement except for a median transverse row which crosses the central keel at right angles a little below the attachment of the uropoda; one of these tubercles on either side, close to the lateral margin, is considerably larger than the rest.

Of the *first pair of antennæ* the two proximal joints are short, while the third, which is the longest, measures about twice the length of the second. The joints of the filament are extremely short and numerous; there are about fifty; each joint bears two sensory filaments instead of the usual one (Pl. VI. fig. 5).

In the *second pair of antennæ* the third joint has a large backwardly projecting tubercle just before its articulation with the following joint as in *Serolis tuberculata;* this joint is also smaller than the preceding one; the fourth and fifth joints are as usual greatly elongated, and the outer margin is sinuous. A tuft of fine hairs springs from the surface of each of the four elevations; the filament consists of fifteen joints, which are longer and more slender than the joints composing the filament of the first pair of antennæ; the upper surface of the third to the tenth joints has a row of short blunt tubercles; one or two long fine hairs springs from the inner margin of each joint at its anterior extremity.

Mouth Appendages.—The *mandibles*, like those of *Serolis pallida*, have a large and conspicuous tooth upon the posterior part of the masticatory edge; behind this is another smaller tooth; in front the margin slopes back gradually to meet the outer margin of the mandible.

The first *maxillæ* are short and rather bent, and resemble those of *Serolis pallida*.

Thoracic Appendages.—The *maxillipedes* (Pl. VI. fig. 6) closely resemble those of *Serolis pallida* and the other Australian species, but are not sculptured like those of the former; the lamina terminates on the inner side in the usual way; on the outer side it is produced into a rounded prominence, which extends some way beyond the notch on the inner side; just behind the articulation of the palp is a broad ridge as in *Serolis pallida;* the anterior margin of the stipes is crenate; the second joint of the palp is not so distinctly cordate in shape as in many species, and resembles in this particular the other allied Australian forms.

The thoracic appendages are furnished with two kinds of spines—(1) short broad serrated spines like those of *Serolis schythei* and many other species, (2) longer and more delicate spines, which are somewhat thicker on the outer edge than on the inner; the extremities are bent inwards; these spines seem only to be found on the appendages of the Australian species. The proximal joint of all the ambulatory limbs has a number of fine branched hairs on the inner surface like those of *Serolis neœra* and other species; the second joint is a little shorter, and has one long hair on the inner side just before its articulation with the succeeding joint; the third, fourth, and fifth joints are short, but increase in length up to the fifth. One of the thoracic appendages is shown in fig. 8; the others are similar except that the three penultimate joints increase in length in the posterior limbs; in the appendage figured it will be seen that the spines on the outer side arise from step-like processes, on the three penultimate joints the number of these steps gradually increases in the posterior appendages. In the male the second thoracic appendage, as in all other species, is modified into a prehensile organ; the penultimate joint is rather more elongated than usual, and its two sides are almost parallel; on the inner surface I counted in one specimen nine of the hairs peculiar to this joint.

The first three pairs of *abdominal appendages* have no hairs upon the basal joint, and the two sides of this joint are nearly parallel owing to the absence of the inner projecting angle.

Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ E.; 38 fathoms; bottom, sand and shells.

13. *Serolis elongata*, F. E. B.

Serolis elongata, F. E. Beddard, Proc. Zool. Soc. Lond., 1884, pt. iii. p. 335.

Although I have been able to examine only a single female example of this species, its characters appear to me to be sufficiently different to retain it as a distinct species.

The specimen is a female with fully developed ovigerous lamellæ; its greatest length is 10 mm., its greatest breadth 6·5 mm. It is most nearly allied to *Serolis australiensis*, from which, however, it differs in several respects.

From the above measurements, when compared with those of *Serolis australiensis* (*ante*, p. 68), it will appear that *Serolis elongata* is rather narrower, the length being proportionately greater than the breadth.

The main difference, however, between the two species is the development of tubercles upon the dorsal surface of the body; *Serolis australiensis* is to be distinguished from all other species of the genus by the immense number of tubercles upon the segments of the body, and also upon the caudal shield; in *Serolis elongata* the dorsal surface of the body is by comparison almost smooth; this cannot be owing to the difference of age; the female specimen of *Serolis elongata*, although actually smaller than *Serolis australiensis*, is perfectly mature, with fully-developed ovigerous lamellæ; and as no other species that I have been able to examine undergoes any change, except mere increase in size, as soon as it has attained to maturity, there is no reason to suppose that *Serolis elongata* is peculiar in that respect. As in *Serolis australiensis*, each of the segments of the body is furnished with a curved hook-like spine in the middle line; a row of short tubercles occupies the hinder portion of each of the segments, and is prolonged on to the epimera; besides these there appear to be a few scattered tubercles over the rest of the segments and the epimera, which are very inconspicuous, and contrast with the strongly tuberculated surface of the body in *Serolis australiensis*.

The caudal shield has the same general shape that it has in the last mentioned species, with serrated margins and a longitudinal carina. There is also a lateral carina on either side bearing a short spine, which is situated about half way down the caudal shield, and a little below the place where the uropoda are attached, and terminating at the end of the body by becoming fused with the central carina; as in *Serolis australiensis*, these lateral carinæ are serrated. Between these and the central carina is a short ridge running obliquely towards the margin of the caudal shield from a point a little below and to one side of the commencement of the central carina; the general surface of the caudal shield is smooth, and there are only present a few scattered tubercles, especially developed in the neighbourhood of the two lateral carinæ.

Port Jackson, Sydney, 30 fathoms.

14. *Serolis longicaudata*, F. E. B. (Pl. VII. figs. 8–10; Pl. VIII. figs. 1, 2).

Serolis longicaudata, F. E. Beddard, Proc. Zool. Soc. Lond., 1884, pt. iii. p. 336.

Of this species the Challenger obtained one immature female; its length is 7 mm., its breadth 5 mm.

The general form of the body is peculiar, and unlike that of the typical members of the genus; the anterior portion of the body, comprising the head, thorax, and free abdominal segments is almost completely circular, and the caudal shield projects backwards for a considerable distance, being proportionately longer than in any other of the species

known to me, while the epimera are all short and abruptly truncated, reaching in no case beyond the lateral margins of the caudal shield.

The *cephalic shield* terminates in front in a comparatively long rostrum; behind, the suture which separates it from the thoracic segment is incomplete in the middle line, and for a space on either side of it extending to nearly as far as the level of the eyes; the cephalic shield as well as the rest of the body is quite smooth, and free from tubercles.

Thorax.—The epimera of the first thoracic segment are entire and devoid of any trace of a transverse suture; the epimera of the remaining thoracic appendages are very short, and have the appearance of being truncated at their free extremity; the anterior margin of the epimeron, instead of passing insensibly into the outer lateral margins, meets it almost at right angles, and the outer margins run backwards in a direction almost parallel to the long axis of the body; the epimera of the three anterior free thoracic segments are separated by a distinct suture from their terga. The epimera are extremely short, as may be seen in Pl. VIII. figs. 1, 2, where this species is figured. The two last thoracic segments have the same characters that are peculiar to the other Australian species of the genus; the tergum of the fifth is extremely narrow, not more than one-fourth the breadth of the segment in front; the tergum of the sixth segment is entirely absent. The sutures which separate both segments from the succeeding and preceding ones entirely disappear close to the middle line of the body.

The outer margins of all the thoracic epimera are faintly serrated. Ventrally the middle portion of the segments is elevated into a broad ridge which becomes higher towards the middle line, and slopes off gradually in the direction of the epimera; in the sixth segment this ridge is still more marked, and being developed upon its posterior border overlaps the terminal thoracic segment. The terminal segment of the thorax bears on either side, close to and just above the attachment of the first abdominal limb, a circular aperture which may be the outlet of some gland. I observed a similar pair of orifices in *Serolis pallida* and in several other species.

Abdomen.—The epimera of the second and third abdominal segments extend as far as the edge of the caudal shield; the outer margin of the second is concave, that of the third nearly straight. The ventral portion of the first three segments is furnished with a central triangular keel which projects some way back as a stout conical spine; the spine is largest upon the first segment, and its cavity communicates with the exterior by several large fenestræ upon the lower surface (Pl. VII. fig. 8).

The *caudal shield* has a somewhat pentagonal outline, and terminates in an abruptly truncated extremity; the dorsal surface has a middle and two lateral carinæ; the portion which lies beyond the latter is strongly bent down; the postero-lateral margins are slightly denticulate.

Appendages.—The *antennæ* are displayed in figs. 9 and 10 of Pl. VII. The anterior pair (fig. 9) are rather shorter than the second pair; their terminal filament has thirteen

joints. In the posterior antennæ (fig. 10) the filament has ten joints; the two last joints of the basal portion of the antenna are furnished with tufts of fine hairs springing from shallow depressions on the anterior surface.

The *ambulatory limbs* are remarkable in that they are only furnished with comparatively slender, soft, bluntly terminating spines; no serrated spines appear to be present. The inner side of the first joint of all these appendages has a row of about a dozen fine branched hairs entirely like those found in many other species; the second joint in all is rather smaller than the first, and has on the inner side just before its termination a single long slender spine; the remaining joints are subequal in size and comparatively short; the fourth and fifth joints in the penultimate pair of appendages are longer and narrower than in the preceding limb, and about half as long again as the third joint.

The last pair of thoracic appendages is as usual small.

The *three first abdominal appendages* have the basal portion comparatively long and narrow, and as in other Australian species the inner and lower margins are not prolonged into a triangular process furnished with two or three branched hairs.

The *fourth pair* or *opercula* have the exopodite divided by a suture at right angles to the longitudinal axis, and terminating exactly at the level of the attachment of the uropoda; the latter are attached at about the middle of the caudal shield, and extend exactly as far as its termination; the endopodite is slightly shorter, and at the same time slightly broader than the exopodite; the margins of both are smooth, and only slightly crenate at the distal end; they bear no branched hairs.

Station 161, April 1, 1874; lat. 38° 22′ 30″ S., long. 144° 36′ 30″ W.; 33 fathoms; bottom, sand.

15. *Serolis pallida*, F. E. B.(Pls. VII. fig. 1; VIII. figs. 6–16).

Serolis pallida, F. E. Beddard, Proc. Zool. Soc. Lond., 1884, pt. iii. p. 335.

Of this species two specimens were obtained, a male and a female. The female is the larger, measuring 16 mm. in length and 13 mm. in breadth; the male measures 9 mm. in length and 7 mm. in breadth.

The body is oval, somewhat pear-shaped, and recalls *Serolis convexa;* as in that species the epimera are closely applied to each other, and only in the last three thoracic epimera are the extremities freely projecting. The colour (in alcohol) is a uniform pale brown, with two darker patches on each side of the third free thoracic segment, the anterior portion of the caudal shield is whitish grey. The surface of the body is quite smooth and free from tubercles except for a series, one to each segment, occupying the median line.

The *cephalic shield* is almost triangular in shape, from the great development of the ocular prominences and a large median backwardly projecting spine; the rostrum is long and slender, and reaches nearly as far as the distal end of the second joint of the posterior antennæ; the anterior margin of the cephalic shield is thickened into a ridge, which bifurcates at the edge, the two branches being directed forwards and enclosing a deep cup-like space; shortly before the bifurcation a small spine-like process is given off anteriorly.

Thorax.—The epimera are short, gradually increasing in length up to the sixth pair; the first epimera are entire as in the other Australian species, and not divided by any transverse suture; at the upper extremity is a short ridge on either side, which extends for about one-sixth of its length parallel to the anterior margin of the epimeron.

In the three succeeding epimera the curvature of the outer margin is very slight, which gives them the appearance of being abruptly truncated. The fifth epimera are more sickle-shaped, since the outer is inclined at a smaller angle to the posterior margin; the outer margin of the sixth epimera is concave.

The terga of the thoracic segments, with the exception of the first and the two last, have a median hooked spine directed upwards and backwards; these increase slightly in size from before backwards; the antero-posterior diameter of three anterior free thoracic segments is about the same; the fourth is not more than one-fifth as wide as the preceding segments, and the tergal portion of the last thoracic, as in other Australian species, has entirely disappeared.

Abdomen.—The epimera of the second and third abdominal segments only reach as far as the margin of the caudal shield; they are equal in length. The terga of the three segments are furnished with a spine like that in the thoracic segments; these spines, which are rather smaller than those on the thorax, increase in size from before backwards. The sterna of these segments are produced into a long median spine, which is larger in the first segment than in the two succeeding ones.

The *caudal shield* in the female measures 5·5 mm. in length, and is therefore rather more than one-third of the length of the entire animal; it is irregularly hexagonal in outline, and keeled; the extremity is notched; the uropoda are attached about half way down; just below and to the inside of the spine-like process which covers the articulation of the uropoda is a minute flattened spine on either side.

The two pairs of *antennæ* are approximately of the same length. The basal joint of the first pair (Pl. VIII. figs. 7, 8) has three strong tubercles on its upper surface; the second joint has a stout tubercle on the posterior margin projecting backwards; the filament has twenty-four joints, each of which is furnished with two sensory hairs (fig. 8), as in *Serolis australiensis*.

In the second pair of antennæ (Pl. VIII. fig. 6) the fifth joint is very much enlarged; it is not quite so long as the preceding joint, but wider; the filament is short, being

composed of nine joints. The second and third joints of the antennæ are raised into tubercles on the upper surface.

Mouth Appendages.—The *mandibles* (Pl. VIII. figs. 9, 10) as well as the maxillipedes (fig. 12) are much sculptured, the under surface being raised into a number of ridges separated by deep depressions as shown in the figure; the masticatory edge, instead of being comparatively straight and smooth, as in the majority of species, is denticulate, one tooth on its posterior boundary being specially prominent. On the upper surface (fig. 10) are two spine-like processes.

The *maxillæ* do not differ much from those of other species; the anterior pair (fig. 11) have a short basal joint, and the terminal joint is much bent.

The *maxillipedes* are shown on fig. 12 of Pl. VIII.; the under surface of the basal portion, instead of being flat and smooth, as is ordinarily the case in *Serolis*, is traversed by a number of ridges, the direction and form of which are displayed in the figure; the second joint of the palp has the peculiar shape that it has in *Serolis australiensis*. The outer margins, instead of being convex, are concave and almost parallel with the inner margins; they are traversed from end to end by a ridge, close to and quite parallel with the outer margins.

The *second pair of thoracic appendages* are shown on fig. 13 of Pl. VIII., and several of the spines from the inner surface of the penultimate joint on figs. 14, 15 of the same plate. The latter are very characteristic in shape—the longer spines terminate in two large oval expansions traversed by longitudinal striæ which converge at the proximal extremity; the anterior of the two is shorter and broader than the posterior; but at the hinder end of the joint they become much smaller and nearly equal in size and similar in shape; between the two wing-like processes the axis of the spine is continued into a thicker cylindrical tapering extremity which reaches a trifle beyond the level of the posterior wing-like process.

The *third pair* are in the male modified in the ordinary way (Pl. VIII. fig. 16). The penultimate joint is oval, and furnished on the inner surface with six or seven pairs of cylindrical spines, the axis of which is prolonged into a short filiform process. The first joint, as in the succeeding ambulatory limb, has a row of fine branched hairs on the inner side.

The *remaining thoracic appendages* are stout and strong, and furnished with serrated spines, especially upon the outer surface; the second joint has invariably a single slender spine springing from about the middle of the inner surface; the third, fourth, and fifth joints increase progressively in size, the fifth joint being nearly or quite as long as the second, though narrower.

The *three first abdominal appendages* have no inner angle bearing hairs upon the basal joint.

The suture which traverses the exopodite of the operculum is at right angles

to the longitudinal axis, and at the level of the end of the first joint of the uropoda.

The *uropoda* are attached just before the end of the anterior half of the caudal shield; the exopodites are longer and reach very nearly up to the distal extremity of the caudal shield; they are oval in shape, and terminate in a blunt extremity; the outer margin is serrated nearly as far as the articulation; the endopodite is relatively broader, and ends in a truncated notched extremity, the outer and the posterior margins are serrated; no hairs were found upon these appendages, but it is very probable that they may have become detached.

Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ E.; 38 fathoms; bottom, sand and shells.

Station 163, June 3, 1874; off Port Jackson; 30 to 35 fathoms.

16. *Serolis minuta*, F. E. B. (Pl. VII. figs. 2–6).

Serolis minuta, F. E. Beddard, Proc. Zool. Soc. Lond., 1884, pt. iii. p. 337.

The Challenger collection contains only one specimen of this species, which is a male, and measures 5 mm. in length and 5 mm. in diameter; this species, therefore, if full grown, is the smallest known.

In general shape *Serolis minuta* resembles very closely *Serolis cornuta;* the outline of the body is almost circular, and the caudal shield projects only a little way beyond the circle. A conspicuous keel runs down the middle of the body.

The *cephalic shield* terminates in front in a short and stout rostrum; the anterior portion, as in most other species, is traversed by a ridge (*cf.* Pl. VII. fig. 2) arising from the base of the rostrum; the ridge is continued on to the epimera; the posterior margin is provided with three blunt tubercles, of which the middle one is the largest; each of the following segments is similarly produced into a blunt tubercle at the median point of the posterior margin.

Thorax.—The *first thoracic segment* is entire, and not separated into two portions by a transverse line of division as is the case in so many other species. The dorsal surface of the remaining segments is prolonged on either side into a triangular process which slightly overlaps the succeeding segment; these processes, which are hollow, serve for the attachment of the muscles moving the limbs; they are situated on the tergal portion of the segment close to its junction with the epimeral portion; while those of the third, fourth, and sixth segments are the largest and most conspicuous.

The tergal portion of the second, third, and fourth segments is separated by a distinct suture from the epimera. The sixth segment is partially fused with the first abdominal segment, the suture which divides them being incomplete for a short space on either side of the median line; its epimera extend about as far as the first third of the caudal

shield; the outer margins of the epimera in all the segments are smooth, without serrations or hairs. On either side of the male generative pores is a slit-like orifice as in *Serolis pallida*, &c.

Abdomen.—The second and third segments are provided with epimera which extend farther than the epimera of the sixth thoracic; those of the third segment reach nearly as far as the middle of the caudal shield. The ventral portion of the three anterior abdominal segments is shown on Pl. VII. fig. 2′, together with the appendages belonging to them; they are oblong in shape, and each overlaps the succeeding one; the posterior margin of the first is almost straight, in the others slightly convex.

The *caudal shield* is almost triangular in shape, and ends in a blunt prolongation; the upper surface slopes gently downward on either side from the central keel; the lateral margins commencing from the attachment of the terminal appendages curve inwards and then slightly outwards, becoming almost parallel just before their termination.

Antennæ.—One of the antennæ of the first pair is figured on Pl. VII. fig. 4; it consists as usual of four joints and a terminal filament; the proximal joint is round and entirely free from hairs; the second joint is the largest, its lower surface is furnished with a row of short hairs which are continued on to the succeeding joint; the third joint is smaller than the second, and the fourth is still smaller. The filament is made up of ten joints, of which the first eight are subequal; the penultimate joint is very small, and the last slender and elongated. The second pair of antennæ (Pl. VII. fig. 5) are about one-third longer than the anterior pair; the basal portion consists of five joints, of which the last is the longest; the three last joints are furnished with bundles of hairs arranged irregularly over the lower surface. The filament is made up of ten joints, and is almost exactly of the same length as the filament of the anterior antennæ, which is an unusual circumstance.

The *mandibles* present the usual form, and terminate in a blunt masticatory edge.

Thoracic Appendages.—The large prehensile organs which form the second pair of thoracic appendages are in general form entirely similar to those of other species, but the spines developed upon the inner margin are as usual distinctive; several of these are shown in Pl. VII. fig. 7.

The *third pair* are modified into a prehensile organ which presents some peculiarities distinguishing it from the same appendage in other species of *Serolis*. Fig. 3 represents the last three joints of the right hand appendage viewed in profile and from beneath.

The terminal joint is furnished with a remarkable tongue-shaped process arising from the inner side close to the distal end; along this runs a median crest like the midrib of a leaf. The penultimate joint has five pairs of conical bent spines which are almost exactly similar in shape to those of *Serolis convexa*. The fourth joint has a bundle of fine closely-set long hairs on its inner surface, as is the case in *Serolis neœra*; the third joint has several smaller bundles of precisely similar hairs separated by intervals from each

other; this recalls the same appendage in *Serolis neœra*, where, however, the third joint is completely covered on its inner side with a dense bundle of hairs.

The succeeding thoracic appendages differ from the same appendages in all other species of *Serolis*, by the fact that they are provided only with long slender hairs; the serrated spines so generally found on the ambulatory limbs are entirely absent. The first ambulatory limb of the left side (fourth thoracic appendage) is displayed on Pl. VII. fig. 6. As in other species, the proximal joint is the largest and has no hairs; the second joint has a few hairs on the inner surface; the three following joints are furnished with hairs arranged in bundles as shown in the figure, and more abundantly developed upon the outer than upon the inner edge.

The remaining ambulatory limbs increase slightly in size with the exception of the last, which, as in other species, is the smallest of the series. In the structure and the arrangement of the hairs upon the several joints, they present only a few very slight differences from the one figured; for example, the second joint bears a single long hair upon its outer surface, except in the last pair, where there are three, separated from each other by equal intervals.

The first three *abdominal appendages* present no special characters worthy of remark, except that the basal joints are entirely unprovided with hairs, and resemble therefore *Serolis schythei*.

The terminal pair of abdominal appendages—the uropoda—are attached close to the upper end of the caudal shield; both the distal joints are narrow and elongated, and slightly serrated upon the outer margin; the inner joint is the shorter of the two, and its posterior margin is markedly dentate, and bears a number of hairs.

The colour of this species (in spirit) is brown, owing to the very slight development of pigment, which is chiefly concentrated along the lateral portions of the terga and the marginal portion of the caudal shield.

The specimen was dredged at Station 161, off the entrance to Port Philip, Australia, on April 1, 1874, in 38 fathoms.

GEOGRAPHICAL AND BATHYMETRICAL DISTRIBUTION.

The geographical range of the genus *Serolis* is almost entirely restricted to the southern hemisphere; so far as is known at present, this is the case with the abyssal as well as the shallow-water species; there is only one exception in *Serolis carinata*, a species which has been described by Lockington,[1] and said to occur so far north as at San Diego in California.

The shallow-water species of *Serolis*, with the exception of *Serolis carinata* and a more doubtful exception, *Serolis paradoxa*,[2] are confined to the Antarctic area.

Within this area there appear to be four centres of distribution, corresponding in fact to all the land masses that lie within it—(1) the shores of South America as far north as lat. 30°, the Falkland Islands and the South Shetlands; (2) Kerguelen, the Crozets, and Marion Island; (3) New Zealand (?); (4) the shores of Southern and Eastern Australia.

A Kerguelen species, *Serolis latifrons*, is also known to occur at the Auckland Islands, off the south of New Zealand, a single specimen having been obtained at Rendezvous Cove in that island during the voyage of the "Erebus" and "Terror." It seems very probable also that the genus will eventually be found to inhabit the shores of New Zealand, though at present there is no certain evidence to that effect. Miers, in his list of New Zealand Crustacea, includes *Serolis paradoxa*, apparently on the authority of a specimen in the British Museum, and the same collection of Crustacea contains a single example of a species which I have identified with the Patagonian *Serolis schythei*, and which is labelled "New Zealand"; in both these cases, however, I believe that the locality is not authenticated beyond a doubt. Considering the general similarity between the Crustacean fauna of the whole "Antarctic region" from Patagonia to New Zealand, it seems very probable that *Serolis* is an inhabitant of the shores of New Zealand. I have called attention later (p. 82) to the fact that *Serolis bromleyana* occurs off the shores of New Zealand in *deep* water.

From the shores of South America seven species have been described; these are *Serolis paradoxa*, *Serolis trilobitoides*, *Serolis gaudichaudii*, *Serolis plana*, *Serolis schythei*, *Serolis convexa*, and *Serolis serrei*; of these species *Serolis gaudichaudii* extends farther north than any of the rest; the original specimen was obtained by M. Gaudichaud[3] near Valparaiso. Cunningham[4] also mentions that he obtained it at the same locality. *Serolis schythei* was dredged during the voyage of the Challenger as far north as the Gulf of Peñas on the west coast; it also occurs in the Strait of Magellan and at the

[1] *Loc. cit.*

[2] This species is stated by Dr. Leach, on the authority of Dufrésné, to inhabit the shores of Western Africa, about the river Senegal, but it has never subsequently been obtained from that locality.

[3] Audouin and Milne-Edwards, *Arch. d. Mus. d'Hist. Nat.*, *loc. cit.*, p. 25.

[4] *Loc. cit.*

Falkland Islands. *Serolis trilobitoides* is said by Eights to inhabit the coasts of the South Shetland Islands, as well as the neighbourhood of Cape Horn; the remaining species seem to be restricted to the Strait of Magellan and the extreme south of Patagonia.

It is possible that *Serolis trilobitoides* will eventually prove to be the same species as *Serolis cornuta* from Kerguelen; the two are at least very closely allied.

With this exception the species that inhabit Kerguelen are in every case quite different from the South American species. Besides *Serolis cornuta*, two others inhabit the shores of Kerguelen, viz., *Serolis latifrons* and *Serolis septemcarinata;* the first of these occurs also in comparatively deep water (210 fathoms) off the Crozets. *Serolis septemcarinata* is common to all three groups of Antarctic Islands, Prince Edward and Marion Islands, the Crozets, and Kerguelen,—while *Serolis cornuta* was dredged off the Crozets during the cruise of the "Gazelle."

Finally the shores of the southern and eastern parts of Australia are inhabited by six species of *Serolis*, viz., *Serolis tuberculata*, *Serolis australiensis*, *Serolis longicaudata*, *Serolis elongata*, *Serolis minuta*, and *Serolis pallida;* these species, with the exception of *Serolis minuta*, form, as has already been pointed out (*ante*, pp. 65, 66), a well marked subdivision of the genus, differing more from either the Kerguelen or the South American species than any of these do from each other.

It is rather premature to draw any general conclusions from these facts, even with regard to the distribution of the genus *Serolis* alone; but it may at any rate be pointed out that the distribution of this genus, as at present known, seems to necessitate the division of the southern hemisphere into two distributional provinces, (1) an Antarctic, reaching from South America to New Zealand, and (2) an Australian.

The genus *Serolis* seems to attain to its greatest development in point of number of individuals on the shores of Patagonia and at Kerguelen; v. Willemoes Suhm states[1] that at Kerguelen *Serolis* forms no less than 20 per cent. of the Crustacean fauna; and that "a large species (*Serolis cornuta*) is the predominant and most characteristic form of all the Crustacea in the shallow water of the Antarctic Islands."

It is true that nearly as many species are now known from Australia as from Patagonia, but the genus does not appear to form an important element in the fauna of the first mentioned locality; only a very few specimens, not more than two or three, of any of the six species were obtained by the Challenger; the fact that no species have been previously described[2] either by resident naturalists or from collections made by exploring vessels, also indicates the rarity of the genus in this region. In Patagonia, on the other hand, there are not only a comparatively large number of species, but the number of individuals is also great, though apparently not forming so important an element in the fauna as at Kerguelen.

[1] *Proc. Roy. Soc.*, vol. xxiv. p. 590.

[2] With the sole exception of one specimen of *Serolis tuberculata* described by Grube, as quoted above.

The deep-sea species of *Serolis* have a wider range to the north than the shallow-water species, though as yet none have been obtained north of the equator; since there are only four deep-sea species known, and, with the exception of *Serolis bromleyana*, only a small number of specimens of each were dredged, it is perhaps rather premature to draw any deductions from the facts, and the following notes must be accepted for what they are worth.

In the first place, it must be noted that in no case do any of the shallow-water species pass the 300 fathom limit; nor are any of the deep-sea species known to inhabit shallow water; the shallow-water are specifically distinct from the deep-sea forms. I may correct here a misleading statement in Gerstaecker's account of the Isopoda in Bronn's Thierreichs, from which it would appear that one species is common to "deep" and "shallow" water; on p. 241 of the above quoted work, Gerstaecker gives a list of the range in depth of the family Serolidæ, and one species, which is my *Serolis antarctica*, is stated to occur in 100 fathoms off the Brazilian coast, and again in 1375 and 1600 fathoms in the neighbourhood of the Crozets; 100 is a misprint for 400, which is the actual depth at which the species was dredged.

Two out of the four deep-sea species have a comparatively wide horizontal as well as vertical distribution; one of these, *Serolis antarctica*, occurred at Station 120 (675 fathoms), off Pernambuco, and again at Stations 146 and 147 (1375 and 1600 fathoms), between Prince Edward Islands and the Crozets; the other, *Serolis bromleyana*, was obtained at four localities between Australia and New Zealand, Station 164B (410 fathoms), at Stations 168 and 169, off the east coast of New Zealand, in 1100 and 700 fathoms, and again, considerably to the south, close to the Antarctic Ice-Barrier, at Station 156 (1975 fathoms); Gerstaecker, in the work already alluded to, calls attention to an obvious corollary from these facts (which have been already mentioned in v. Willemoes Suhm's Preliminary Report on the Crustacea observed during the voyage of the Challenger[1]), namely, that these two species, as well as others which have a wide distribution, are found in deeper water passing southwards from the equator to the pole; the facts in the distribution of *Serolis bromleyana* appear to me to furnish grounds for another deduction, that the size of the individuals increases as they pass southwards and into deeper water; the specimens dredged at Stations 164B and 169 (410 and 700 fathoms respectively) are all small; out of the nine or ten specimens dredged at Station 168, farther south and deeper water (1100 fathoms), five are of considerable size, almost twice as large as those obtained at the two first-mentioned stations; finally, at Station 156, the southernmost point at which the species was dredged, two specimens half again as large as the largest of those from Station 168 were dredged up from 1975 fathoms.

Serolis antarctica also agrees in these respects with *Serolis bromleyana*, though the facts in this case are not so strong, inasmuch as only a single specimen was dredged at

[1] *Proc. Roy. Soc. Lond.*, vol. xxiv. p. 585, 1876.

the northernmost station in comparatively shallow water (Station 120, 675 fathoms); this specimen is, however, distinctly smaller than any of those obtained in deeper water at Stations 146 and 147.

It must be remembered, of course, that Gerstaecker's statements as well as mine depend after all upon very few facts; it would be extremely rash at present to insist upon any such generalisation as has been put forward by Gerstaecker in the work already quoted, but it seems worth while to call the attention of naturalists to the facts such as they are.

The remaining deep-sea species were dredged close to the east coast of South America; *Serolis gracilis* from a single Station (Station 120), off Pernambuco, in 675 fathoms, and *Serolis neæra* from two Stations close together and a little farther to the south, off Buenos Ayres, at Stations 320 and 318, in 600 and 2040 fathoms respectively; 2040 fathoms is the greatest depth which the genus is known to inhabit.

It appears therefore that the deep-sea forms of the genus, although not absolutely confined to the neighbourhood of the great continents, attain to their greatest development both in number of species and individuals in this situation, and are never found at any distance from some land—continent or oceanic island.

The genus *Serolis* has evidently originated in the southern hemisphere, probably round the shores of the south polar continent, and has thence spread northwards, its range being apparently limited by temperature; accordingly we find that in every case those species which occur near the equator (*Serolis gracilis, Serolis antarctica, Serolis neæra*) occur there in deep water where the conditions, as far as temperature is concerned, are not so different from the conditions which must obtain on the shores of Kerguelen and Patagonia; the one fact, however, which seems to militate against such an hypothesis is the occurrence of *Serolis carinata* in *shallow* water as far north as San Diego in California. It must be remembered, however, that the temperature of that portion of the Pacific is not so high as might be expected from its latitude; a cold current from the Antarctic area sweeps along the western shores of South America, and the existence of this current has perhaps rendered it possible for *Serolis carinata* (or its ancestors) to migrate farther to the north than would be possible, for example, on the eastern shores of the same continent; moreover, a glance at the map of the world will show that here alone is there any direct land communication between the area occupied by the shallow-water species of the genus *Serolis* in the southern hemisphere and the more northern regions; elsewhere tracts of deep water have possibly aided in preventing their access to the equatorial regions and the northern hemisphere, though it seems more probable, from what has already been said, that the distribution of the group has been more restrained by conditions of temperature than by any other cause.

Comparing the deep-sea with the shallow-water species of *Serolis*, it appears (1) that the genus is pre-eminently a shallow-water genus, the number of deep-sea forms being

comparatively small; (2) that, as has already been pointed out, the deep-sea are in all cases distinct from the shallow-water species; (3) that the deep-sea species show certain peculiarities, notably in the structure of the eyes, which, as has already been described (p. 20 *et seq.*), are either entirely absent (*Serolis antarctica*) or, if present, show great evidence of functional degeneration; none of the deep-sea species possess well-developed eyes. To compensate for the want of eyes, there is a great development of sensory hairs on certain of the appendages; the males of *Serolis neœra*, *Serolis bromleyana*, and *Serolis gracilis* have, upon the third, fourth, and fifth joints of the third thoracic appendages, tufts of sensory hairs, which have already been described (pp. 55, 59, 62; Pl. IV. fig. 6; Pl. V. fig. 8). This structural feature is not, however, peculiar to the deep-sea species, inasmuch as it is also found in *Serolis paradoxa;* but since it occurs in three out of the four, and *Serolis paradoxa* is the only shallow-water species in which I have noticed it, it may be considered as characteristic. *Serolis antarctica* does not agree with the other deep-sea species in this respect, but the first pair of antennæ are furnished with a larger number of sensory filaments than is usual—two upon each joint of the filament; several shallow-water species, however, *Serolis pallida*, *e.g.*, and *Serolis convexa*, present the same character.

In two of the deep-sea species, *Serolis bromleyana* and *Serolis neœra*, the genus attains to its greatest size, and these are indeed among the largest of the Isopoda; as a general rule the deep-sea representatives of the Isopoda are not distinguishable from their shallow-water allies by their greater size; there are exceptions to this rule, notably in the case of *Bathynomus*, a deep-sea genus recently described by Milne-Edwards, which is no less than 9 inches long; and the Challenger collection contains a specimen of another Isopod belonging to the same family Cymothoadæ, which is also of considerable size. The elongated and spine-like epimera of *Serolis neœra* and *Serolis bromleyana*, and also, though to a less extent, of *Serolis gracilis*, are unlike anything that is met with in the representatives of the genus from shallow water, where the epimera are always moderately developed in comparison. In all the deep-sea species, without exception, the ambulatory limbs are furnished with comparatively few spines, which are generally soft and delicate. The strong sword-like and serrated spines so commonly found in the shallow-water members of the group are either completely or partially absent; a very general character, inasmuch as it is found in two out of the four deep-sea species (*Serolis neœra* and *Serolis gracilis*), is the presence, upon the ambulatory limbs, of plumose hairs similar to those which are found upon the abdominal appendages; in *Serolis neœra* especially are these plumose hairs developed in great abundance. They have been more particularly described above, on pp. 55, 56.

The maxillipedes in all the deep-sea species possess a short tubercle on the inner side of the middle joint of the palp, which may represent some kind of sense organ, though the hairs with which it is thickly covered are in no way different from the hairs

which cover the rest of the palp. This is represented in Pl. III. fig. 10, *a*, which is drawn from the maxillipede of the right side of *Serolis gracilis;* with this figure may be compared Pl. I. fig. 11, which represents the same appendage in *Serolis cornuta;* this character is so trifling, that if it were not regularly present in all the deep-sea species, and as regularly absent from all the shallow-water species, with which I am acquainted, it would indeed be hardly worth mentioning. In a young specimen of *Serolis antarctica* from the brood cavity of the mother, in which the appendages are still in a comparatively undeveloped condition without any hairs and spines, this prominence is conspicuous upon the palp of the maxillipede, and is armed upon its upper surface with a short pointed spine; it is possibly the rudiment of some structure highly developed in the ancestors of the group.

NOTE.

In the Plates which accompany this Report the figures of the animals themselves were in most cases drawn by Mr. Mintern from the actual specimens; the appendages were lithographed by him from my drawings. When not otherwise stated the figures are magnified from 10 to 30 diameters.

PLATE I.

PLATE I.

SEROLIS CORNUTA.

Fig. 1. Male, natural size.

Fig. 2. Female, natural size.

Fig. 3. Immature male, natural size.

Fig. 4. Terminal joints of one of the anterior antennæ to show the sensory hairs (*b*).

Fig. 5. Terminal joints of one of the posterior antennæ.

Fig. 6. Isolated joint towards the middle of the flagellum of posterior antenna.

Fig. 7. Distal half of left mandible, upper surface.

Fig. 8. Distal half of right mandible, upper surface.

Fig. 9. Maxilla of second pair of appendages.

Fig. 10. Same appendage of opposite side to show the occasional asymmetry of the maxillæ.

Fig. 11. Maxillipede.

Fig. 12. First abdominal appendage of right side.

Fig. 13. Second abdominal appendage of right side.

Fig. 14. Third abdominal appendage of right side.

Fig. 15. Several of the hairs fringing the endopodite and exopodite of abdominal appendages.

Fig. 16. A portion of one of the same; more highly magnified.

Mintern Bros. lith.

SEROLIS CORNUTA, Studer.

PLATE II.

PLATE II.

Figs. 1–4. SEROLIS LATIFRONS.

Fig. 1. *Serolis latifrons* (variety), female.

Figs. 2, 3. Terminal portions of mandibles, upper surface.

Fig. 4. Terminal joint of second antenna, with commencement of flagellum.

Figs. 5–13. SEROLIS SCHYTHEI.

Fig. 5. A single joint from the filament of anterior antenna; *b*, sensory hair.

Fig. 6. Three joints from filament of posterior antenna in male.

Fig. 7. Spines from the inner surface of penultimate joint of second thoracic appendage.

Fig. 8. Third thoracic appendage of male.

Fig. 9. One of the ambulatory limbs.

Fig. 10. Maxillipede.

Fig. 11. Upper lip.

Figs. 12, 13. Distal end of mandibles, upper surface.

Fig. 14. *Serolis septemcarinata*, nerve cords and ganglia.

Mintern Bros. lith.

1–4. SEROLIS LATIFRONS, White. 5–13. SEROLIS SCHYTHEI, [illegible]
SEROLIS SEPTEMCARINATA, Miers.

PLATE III.

PLATE III.

Figs. 1–6. Serolis antarctica.

Fig. 1. Male, dorsal surface.

Fig. 2. Male, ventral surface.

Fig. 3. Female, dorsal surface.

Fig. 4. Sclerites and appendages in region of mouth, prepared by boiling in caustic potash.

Fig. 5. Third thoracic appendage of male.

Fig. 6. One of the ambulatory limbs.

Figs. 7–13. Serolis gracilis.

Fig. 7. Male, dorsal surface.

Fig. 8. Female, dorsal surface.

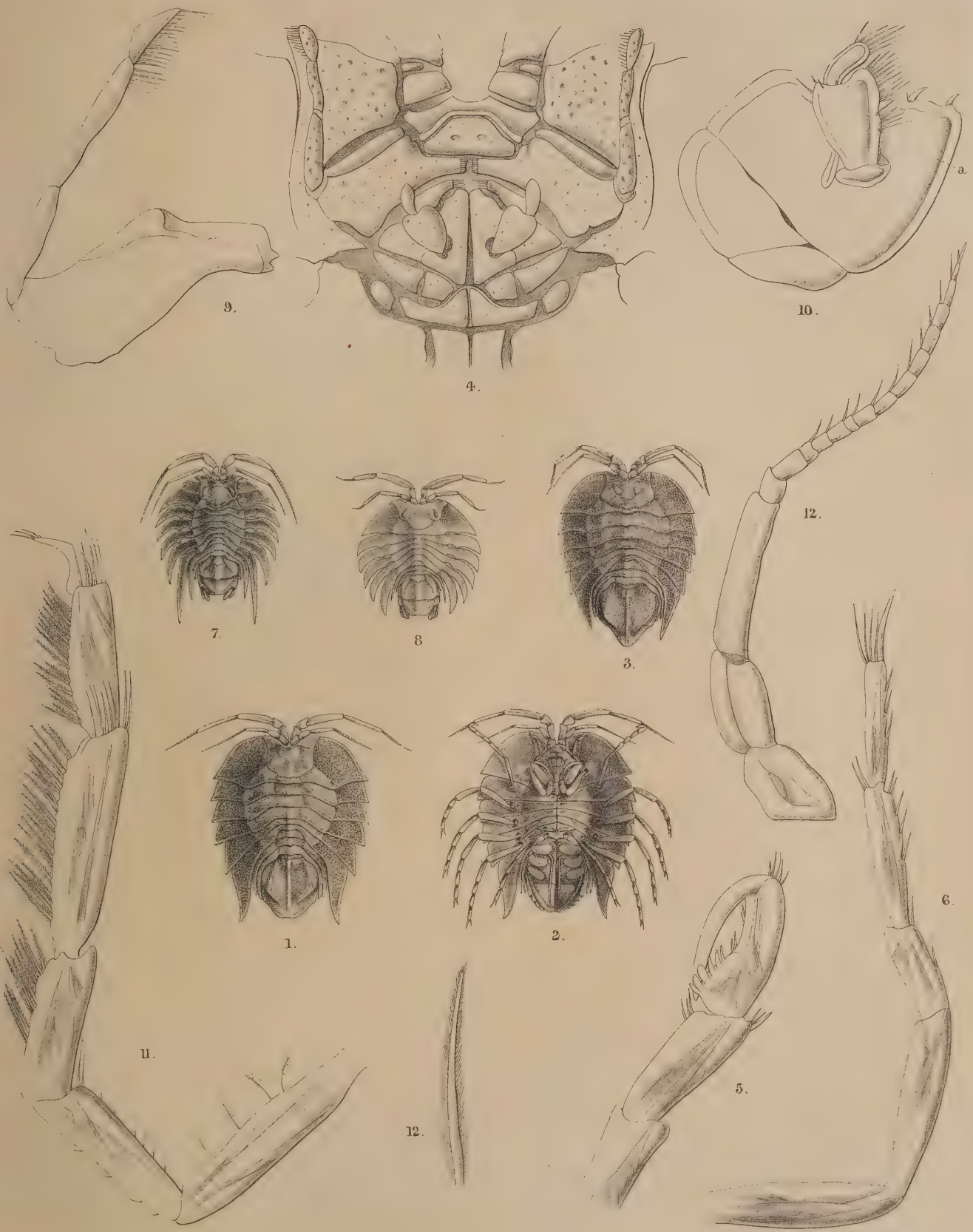
Fig. 9. Mandible, lower surface.

Fig. 10. Maxillipede, lower surface.

Fig. 11. One of last pair of thoracic appendages of male.

Fig. 12. One of the hairs which fringe inner surface of distal joints of same appendage; more highly magnified.

Fig. 13. One of the second pair of antennæ.



Mintern Bros. lith.

1–6. SEROLIS ANTARCTICA, Beddard. 7–12. SEROLIS GRACILIS, Beddard.

PLATE IV.

PLATE IV.

SEROLIS BROMLEYANA.

Fig. 1. Male, dorsal surface.

Fig. 2. Male, ventral surface.

Fig. 3. Male (variety), with longer epimera.

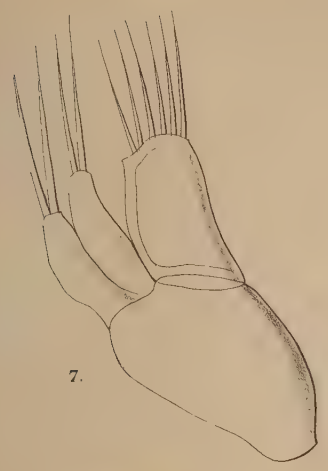
Fig. 4. Female, dorsal surface.

Fig. 5. Distal joints of third thoracic appendage of male.

Fig. 6. Distal joints of another individual fringed with numerous sensory hairs (a).

Fig. 7. Second maxilla.

Fig. 8. Maxillipede.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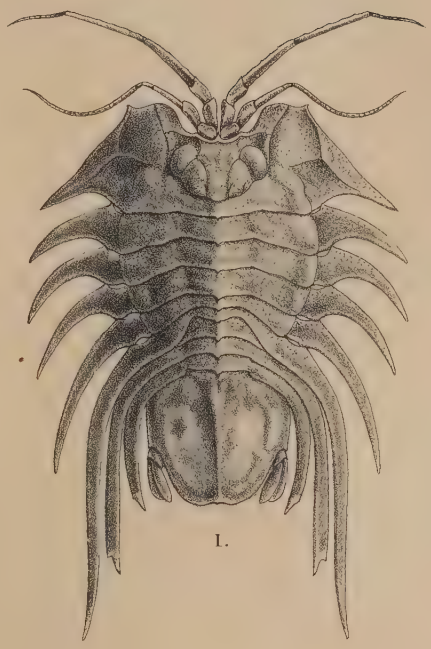
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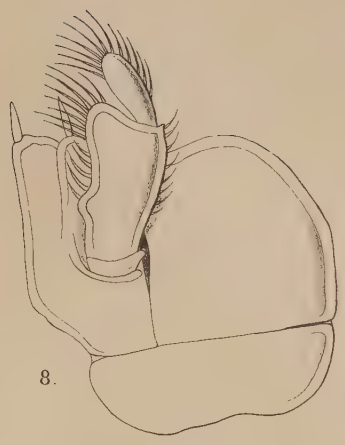
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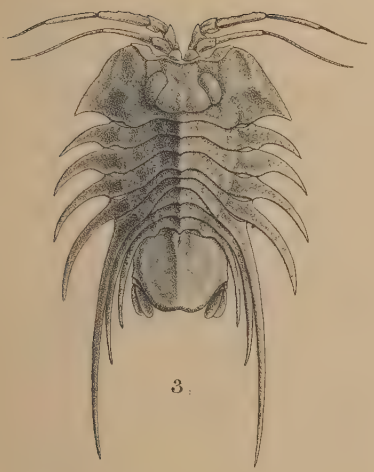
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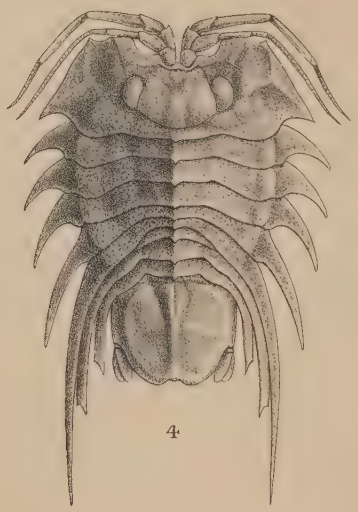
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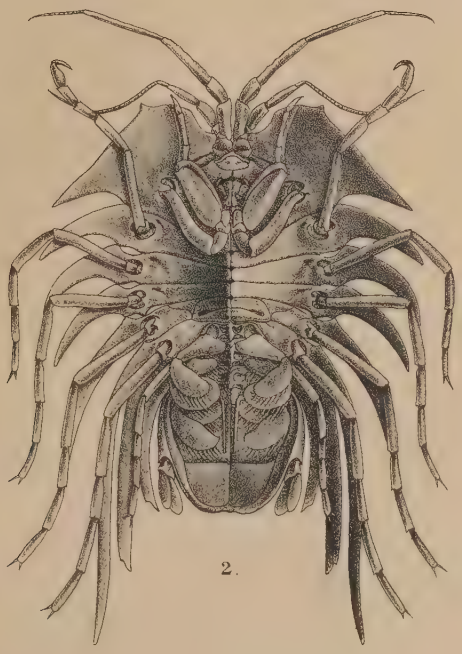
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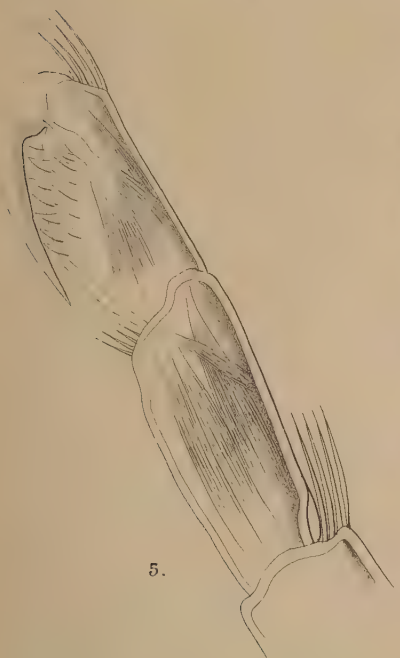
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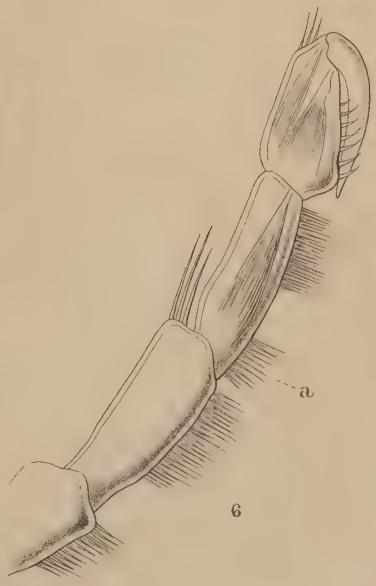

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Mintern Bros. lith

SEROLIS BROMLEYANA, Suhm.

PLATE V.

PLATE V.

Figs. 1–11. Serolis neæra.

Fig. 1. Male, dorsal surface.

Fig. 2. Male, ventral surface.

Fig. 3. Female, dorsal surface.

Fig. 4. Female, ventral surface, displaying the eggs within the brood cavity.

Fig. 5. Tip of the filament of anterior antenna to show the presence of two kinds of sensory hairs (*a*, *b*).

Fig. 6. Maxillipede.

Fig. 7. Spines fringing inner surface of penultimate joint of second pair of thoracic appendages.

Fig. 8. One of the third pair of thoracic appendages of male.

Fig. 9. Hairs from penultimate joint of same appendage.

Fig. 10. A portion of one of the ambulatory limbs.

Fig. 11. One of fourth pair of abdominal appendages.

Figs. 12–14. Serolis paradoxa.

Fig. 12. Distal half of one of the third thoracic appendages in female.

Fig. 13. Distal half of one of the third thoracic appendages in male.

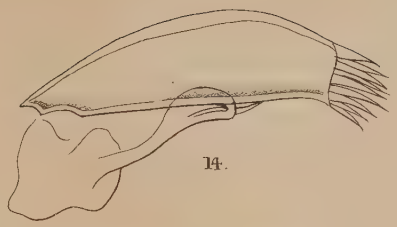
Fig. 14. One of the first pair of maxillæ.

12.

a'

b

9.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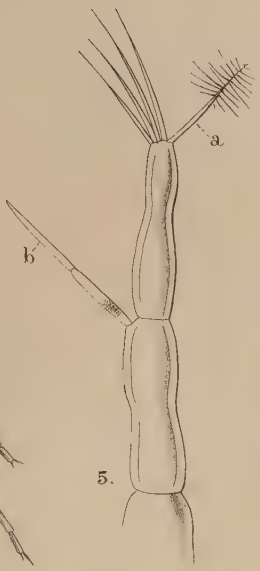
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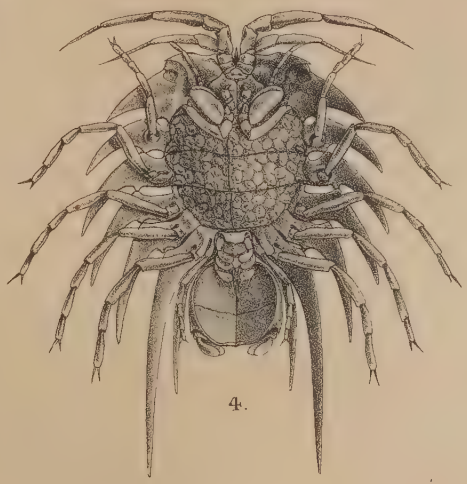
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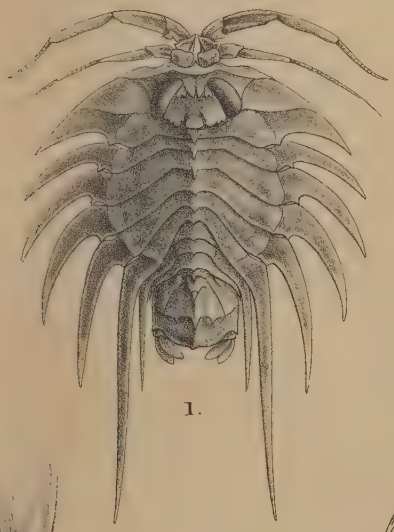
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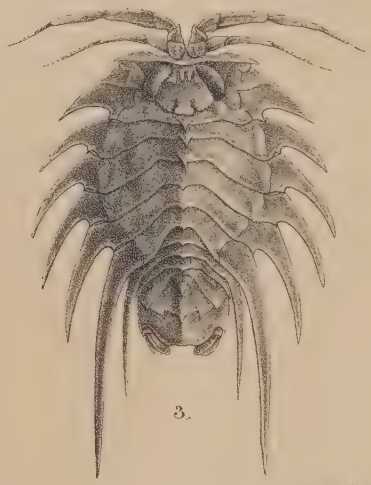
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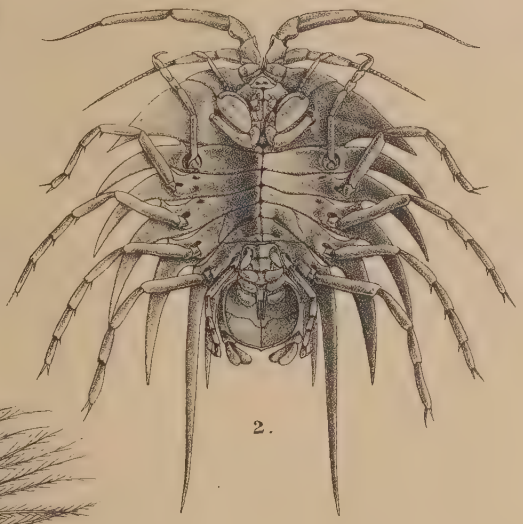
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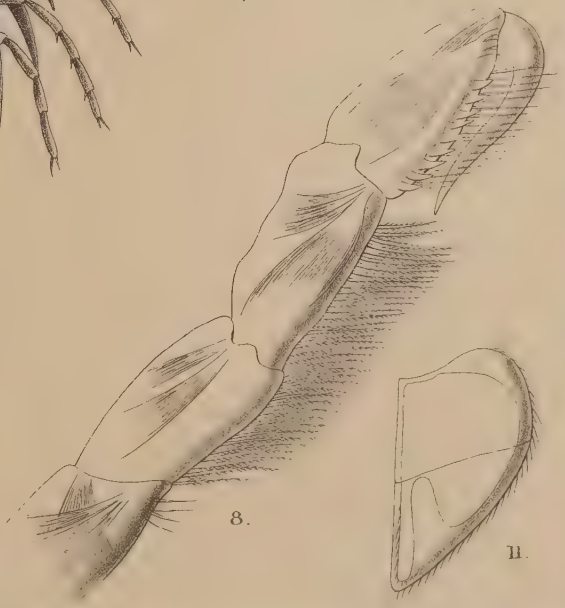
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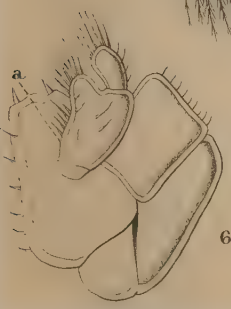
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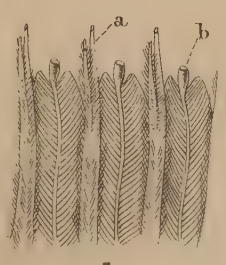
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11.

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1—11. SEROLIS NEÆRA, Beddard. 12–14. SEROLIS PARADOXA, Fabricius.

PLATE VI.

PLATE VI.

Figs. 1–2. Serolis tuberculata.

Fig. 1. Female; magnified three diameters.

Fig. 2. One of the second pair of antennæ.

Figs. 3–8. Serolis australiensis.

Fig. 3. Male, ventral surface; magnified three diameters.

Fig. 4. Female, dorsal surface; magnified three diameters.

Fig. 5. Two joints from filament of first antenna; *b*, sensory hairs.

Fig. 6. Maxillipede of left side.

Fig. 7. Male, dorsal surface.

Fig. 8. One of the thoracic limbs.

Figs. 9–15. Serolis convexa.

Fig. 9. Second thoracic appendage of male; *a*, tuft of sensory hairs.

Fig. 10. Third thoracic appendage of male.

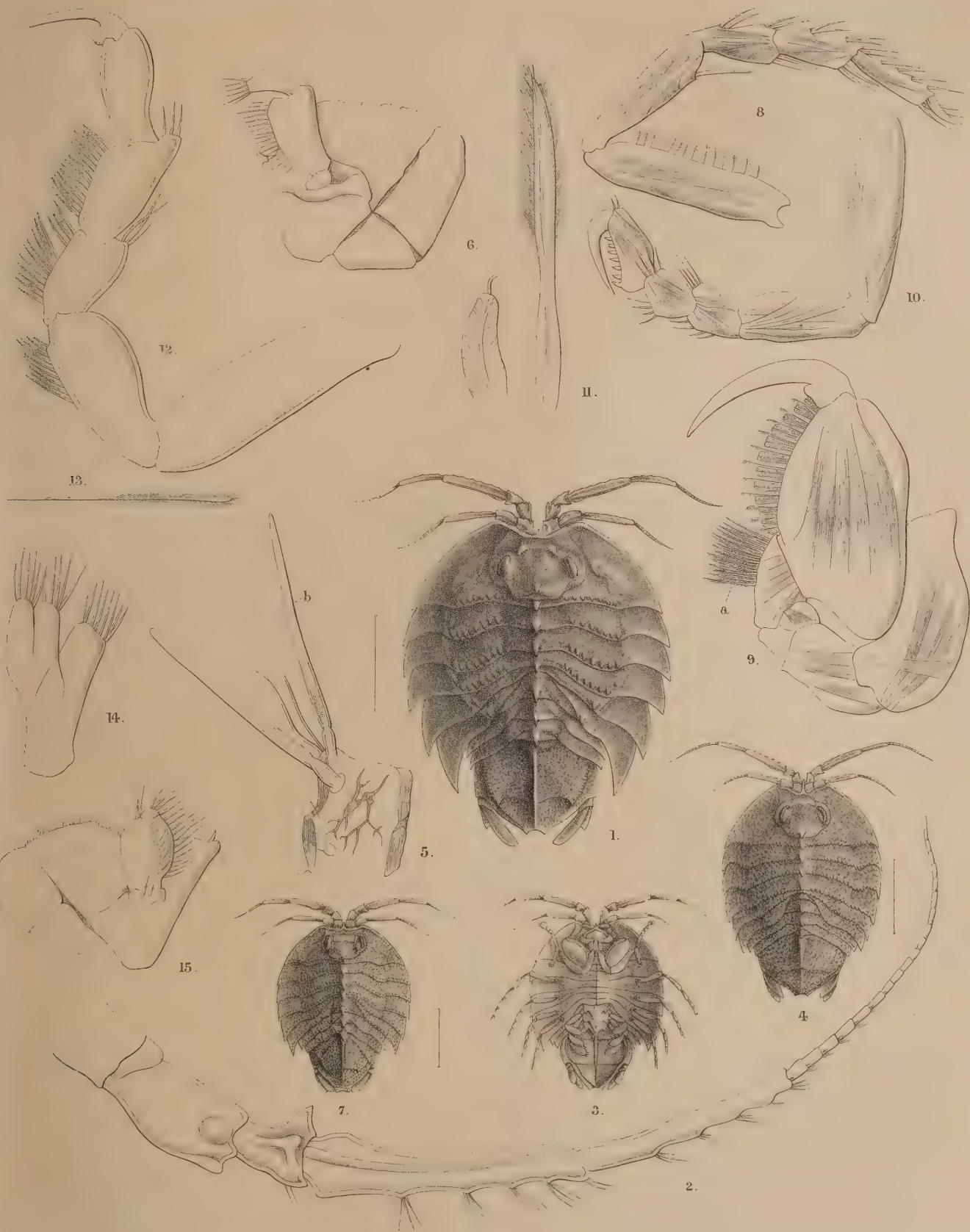
Fig. 11. Two hairs from inner side of penultimate joint of second thoracic appendage

Fig. 12. Terminal thoracic appendage of male.

Fig. 13. One of the hairs fringing the distal joints of the same appendage.

Fig. 14. One of the second pair of maxillæ.

Fig. 15. Maxillipede of right side.



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1–2. SEROLIS TUBERCULATA, Grube. 3–8. SEROLIS AUSTRALIENSIS, Beddard.
9–15. SEROLIS CONVEXA, Cunningham.

PLATE VII.

PLATE VII.

Fig. 1. *Serolis pallida*, female; magnified two diameters.

Figs. 2–7. SEROLIS MINUTA.

Fig. 2. Male; magnified about nine diameters.

Fig. 2′. Abdominal sterna and appendages; *b*, penial filament.

Fig. 3. Third thoracic appendage of male, right side.

Fig. 4. Antenna of first pair.

Fig. 5. Antenna of second pair.

Fig. 6. One of the ambulatory limbs.

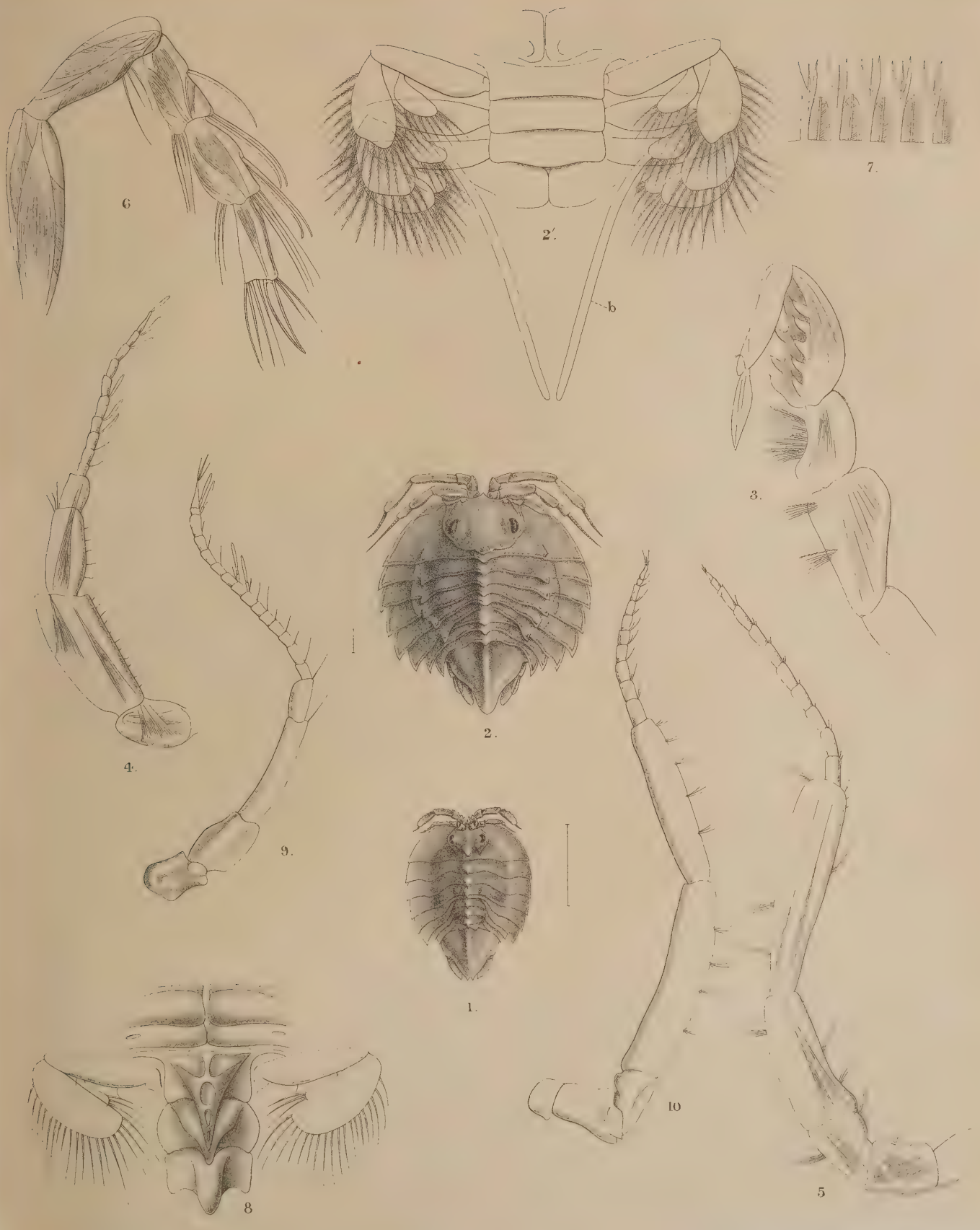
Fig. 7. Spines fringing the penultimate joint of the second thoracic appendage.

Figs. 8–10. SEROLIS LONGICAUDATA.

Fig. 8. Sterna of last thoracic and three first abdominal segments.

Fig. 9. Antenna of first pair.

Fig. 10. Antenna of second pair.



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1. SEROLIS PALLIDA, Beddard. 2—7. SEROLIS MINUTA, Beddard.
8—10. SEROLIS LONGICAUDATA, Beddard.

PLATE VIII.

PLATE VIII.

Figs. 1, 2. Serolis longicaudata.

Fig. 1. Male, dorsal surface.

Fig. 2. Male, ventral surface; both figures enlarged about four diameters.

Figs. 3–5. Serolis septemcarinata.

Fig. 3. Third thoracic appendage of male, left side.

Fig. 4. Base of penultimate joint of same appendage.

Fig. 5. One of the ambulatory limbs.

Figs. 6–16. Serolis pallida.

Fig. 6. Antenna of second pair.

Fig. 7. Antenna of first pair.

Fig. 8. Two joints of the filament with sensory hairs; more highly magnified.

Fig. 9. Mandible of left side, lower surface.

Fig. 10. Terminal portion of left side; more highly magnified.

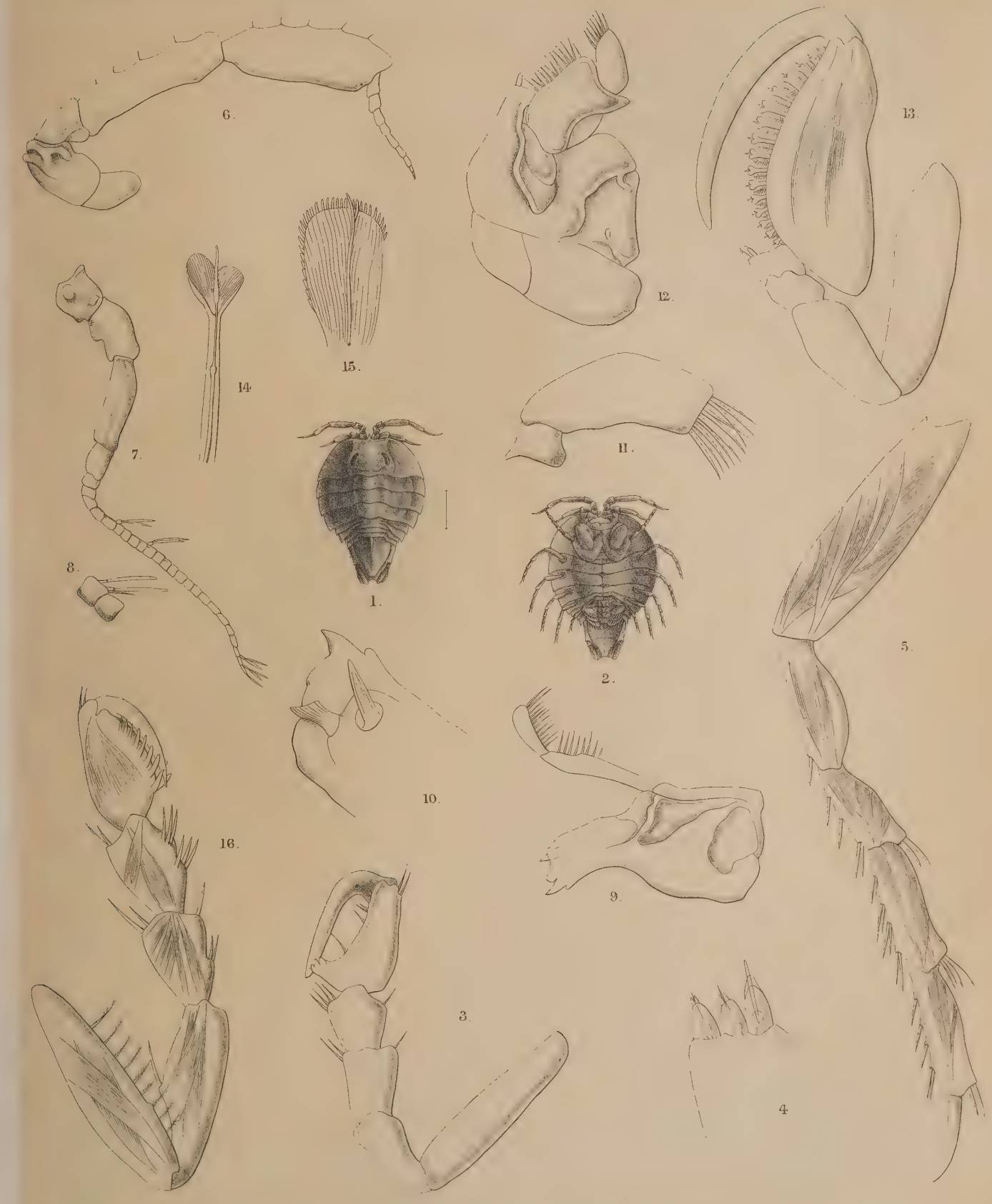
Fig. 11. First maxilla of right side.

Fig. 12. Maxillipede of left side, lower surface.

Fig. 13. One of the second pair of thoracic appendages.

Figs. 14, 15. Spines from inner surface of penultimate joint of same appendage; more highly magnified.

Fig. 16. Third thoracic appendage from right side of male.



Mintern Bros. lith

1–2 SEROLIS LONGICAUDATA, Beddard. 3–5. SEROLIS SEPTEMCARINATA, Miers.
6–16. SEROLIS PALLIDA, Beddard.

PLATE IX.

PLATE IX.

Structure of the Eye.

Fig. 1. Surface view of membrane limiting the "ommateum" below; *a*, perforations for the nerve fibres arranged in groups of four, corresponding to each retinula; *n*, nuclei.

Fig. 2. Semidiagrammatic section through the eye of *Serolis schythei*; *c*, corneal lenses; *n*, nuclei of Semper; *v*, vitreous body; *r*, retinula cells; *p*, pigmentiferous connective tissue corpuscles; *h*, hyaline cells; *s*, rhabdom.

Fig. 3. Single element of the eye of *Serolis cornuta*, depigmented and isolated by teasing; *r*, rhabdom; *r'*, its posterior filiform prolongation; *h*, hyaline cells; *n*, their nuclei.

Fig. 4. Single element of the eye of *Serolis cornuta* to show the pigment sheath surrounding the rhabdom (*r*).

Fig. 5. Single element of the eye of *Serolis schythei*; *r*, rhabdom; *h*, hyaline cell.

Fig. 6. One of the hyaline cells; *n*, its nucleus.

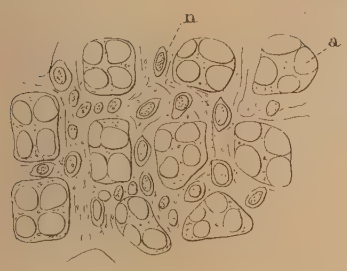
Figs. 7, 8. Transverse section through the upper part of the retinula of *Serolis schythei*; *r*, rhabdom; *p*, pigment.

Figs. 9–15. A series of figures to show the varying form of the rhabdom in *Serolis cornuta*.

Figs. 16, 17. Transverse section through the upper part of the retinula of *Serolis cornuta*; *r*, rhabdom; *p*, its pigment sheath.

Figs. 18, 19. Two isolated retinula cells of *Serolis schythei*; *r*, rhabdomere.

Fig. 20. Series of transverse sections through retinula of *Serolis schythei*; *a*, nervous rods below membrane; *b*, lower end of retinula cell just above the pigmented membrane; *c*, retinula cells at the level of the nucleus (*n*); *d*, four retinula cells surrounding the hyaline cell (*h*); *e*, upper extremity of the retinula cells; (*y*), rhabdomere.



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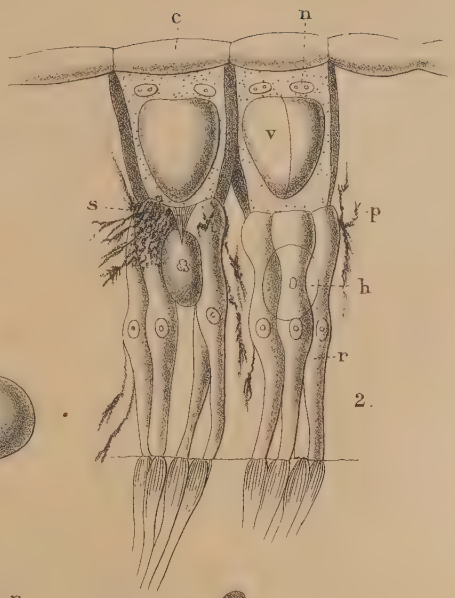

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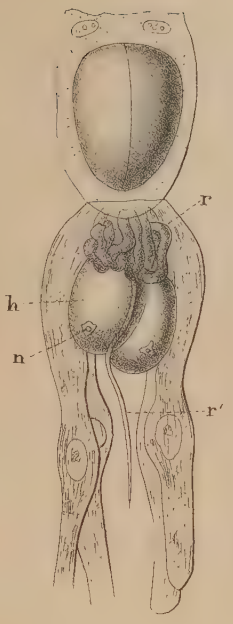

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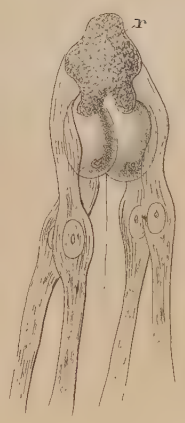

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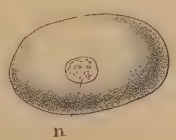

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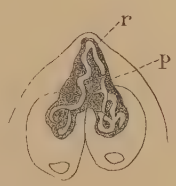

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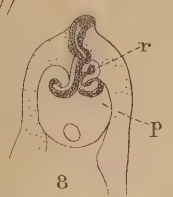

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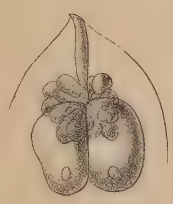

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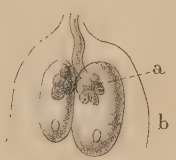

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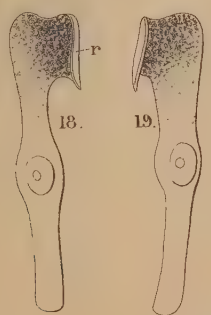

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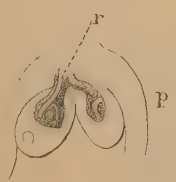


17.

15.

20 a.

20 b

20 c.

20 d

20 e.

PLATE X.

PLATE X.

Structure of the Eye, &c.

Fig. 1. Single element of the eye of *Serolis cornuta*, depigmented by nitric acid; *h*, hyaline cell which has absorbed the pigment.

Fig. 2. Dissection of *Serolis cornuta*; *h*, heart; *hep*, hepatic cæca; *od*, oviduct; *r*, rectum.

Fig. 3. Diagrammatic transverse section through the eye of *Serolis neæra*; *n*, nuclei of Semper; *l*, vitreous body; (*g*) mass of cells below the vitreous body traversed by a network of pigment.

Fig. 4. Masticatory stomach of *Serolis schythei*; *RP*, *LP*, ribbed lateral plates; *l*, *la*, *lp*, lateral ossicles; 1, 2, 3, pyloric ossicles.

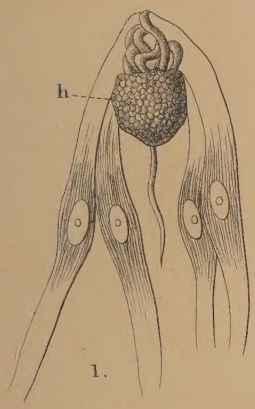
Fig. 5. Diagrammatic transverse section of eye of *Serolis bromleyana*; *h*, vitreous bodies; *c*, cornea; *m*, tissue in which vitreous bodies are imbedded.

Fig. 6. Transverse section through the buccal region of *Serolis septemcarinata*; *a*, entrance to the buccal cavity; *m*, mandible; *b*, buccal cavity; *c*, integument bounding the lower surface of the body; *d*, salivary glands; *e*, connective tissue cells; *n*, nerve commissure.

Fig. 7. Embryo of *Serolis antarctica*; *c*, telson.

Fig. 8. Single element of the eye of *Serolis neæra* isolated by teasing in glycerin; *v*, vitreous body with pigment sheath; *g*, mass of cells below the vitreous body.

Fig. 9. Masticatory stomach of *Serolis bromleyana*; *m*, cardiac ossicle; *V*, ventral ossicle; *RP*, *LP*, ribbed lateral plates; *l*, *la*, *lp*, lateral ossicles; 1, 2, 3, pyloric ossicles; *s*, opening of pylorus; *t*, triangular ossicle.



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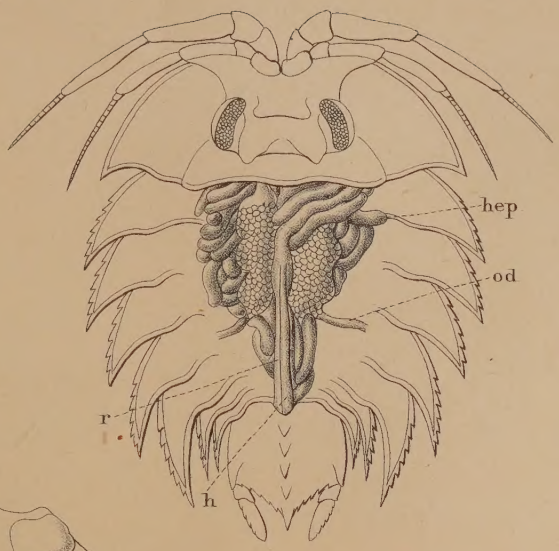

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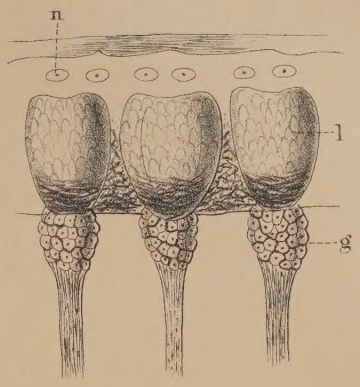

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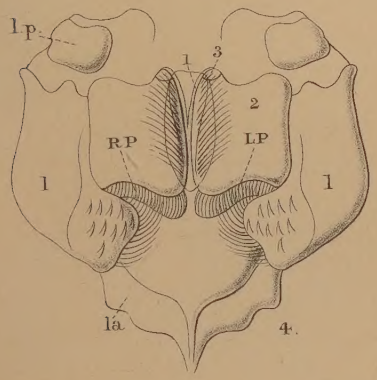

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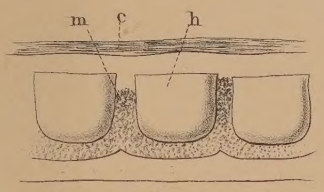

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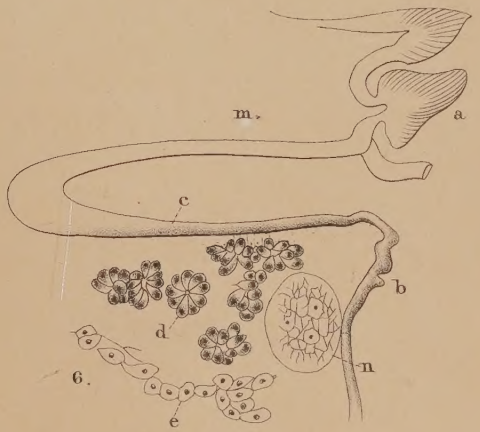

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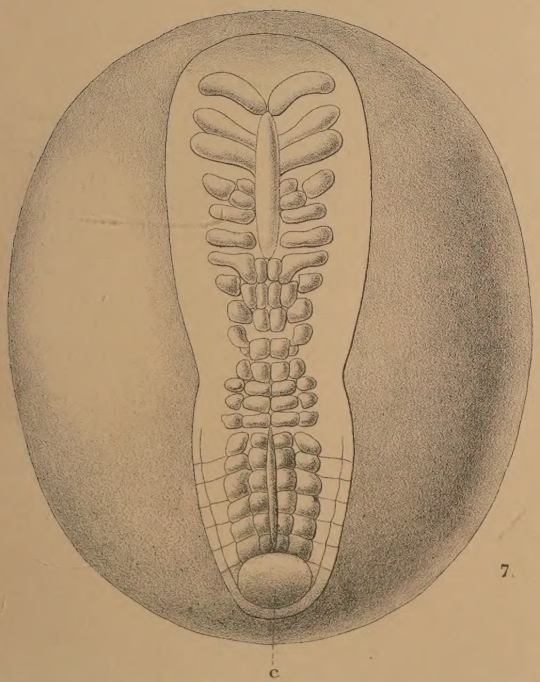

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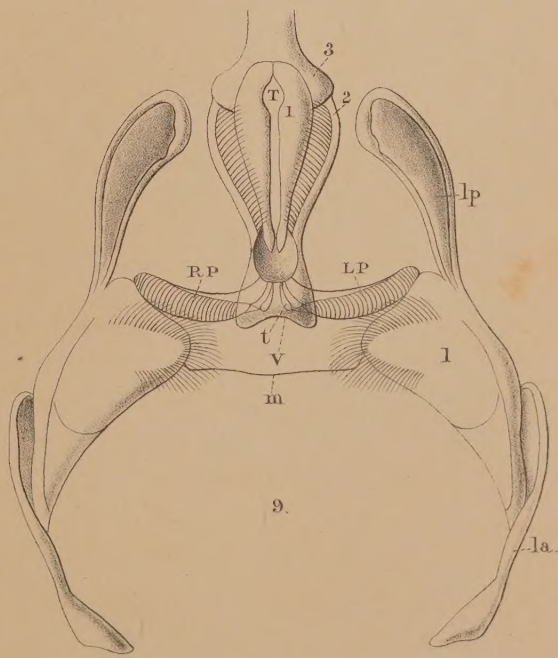

9.

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